EuroValve
January 26-27, 2017

Ascending aorta dilation and aortic valve disease

Ideal follow-up by imaging techniques

Arturo Evangelista

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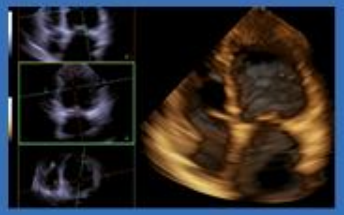

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Faculty disclosure

Arturo Evangelista

I have **no financial relationships** to disclose.

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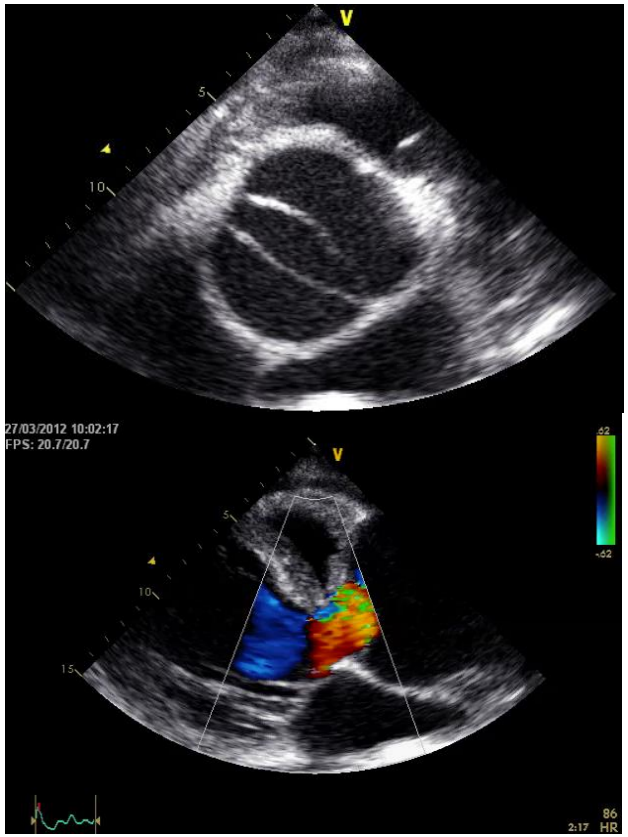
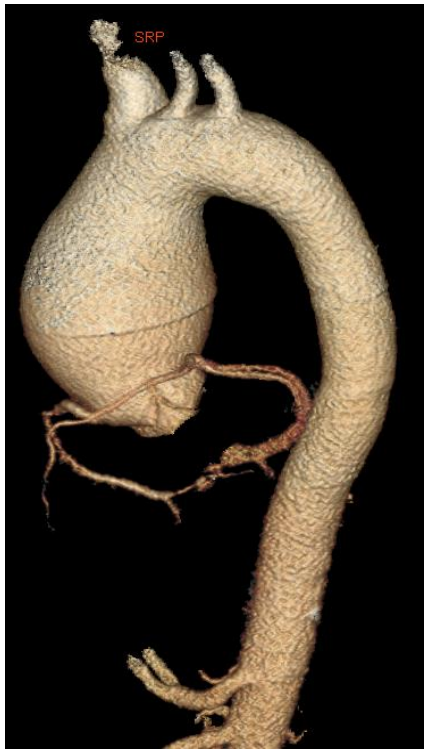
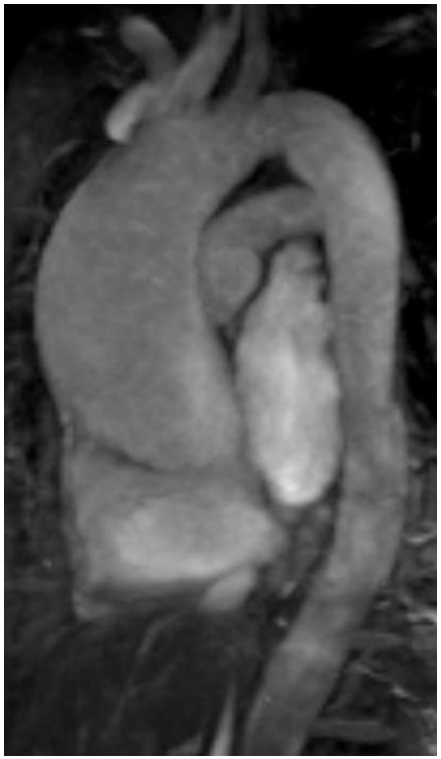
Echocardiography



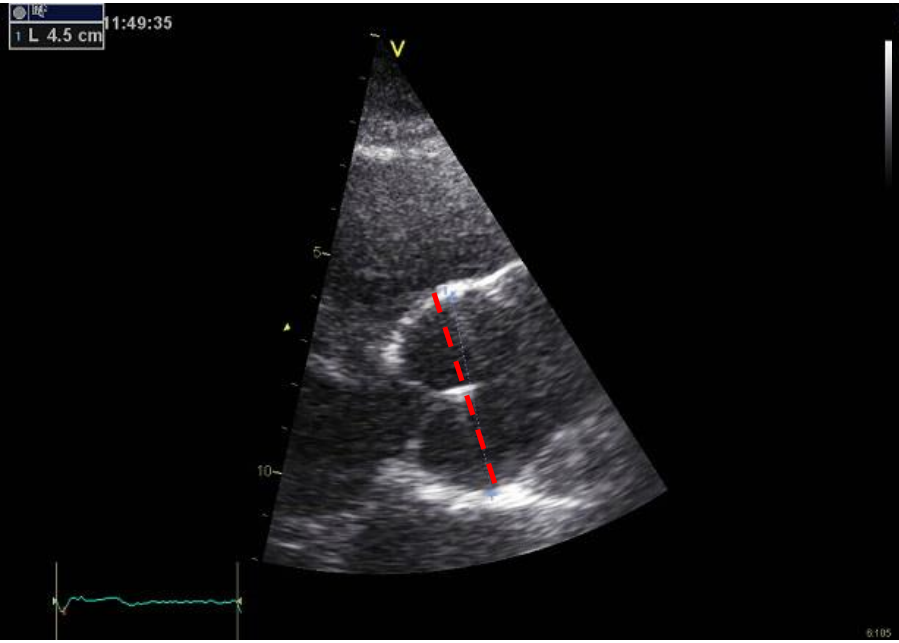
CT

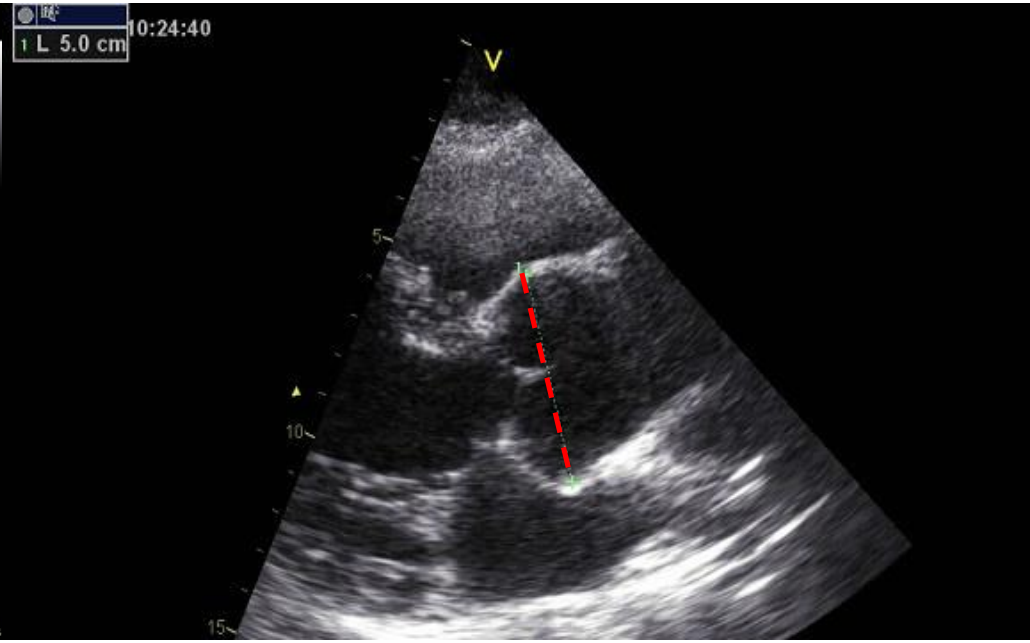


MRI



Maximum aortic diameter follow-up





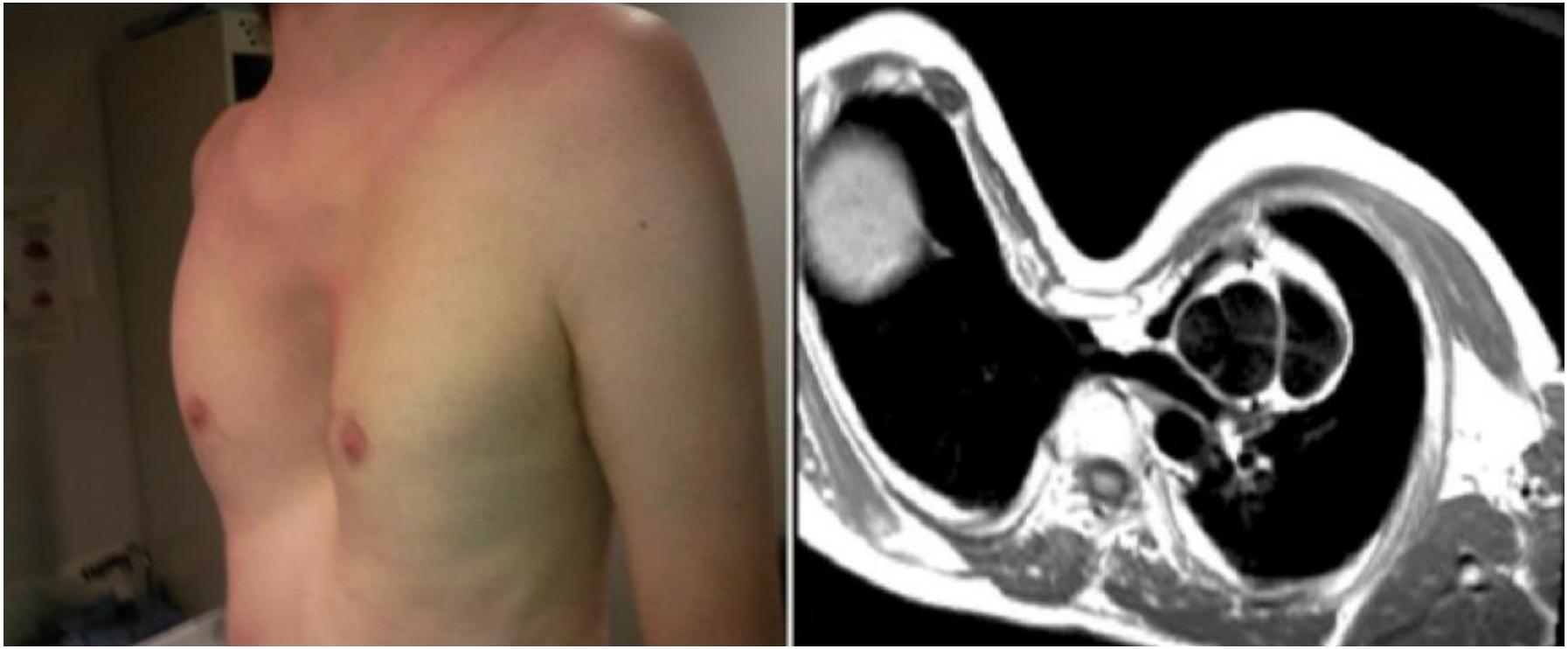
45 mm
7 May, 2010

50 mm
13 May, 2011

At 1 year of follow-up

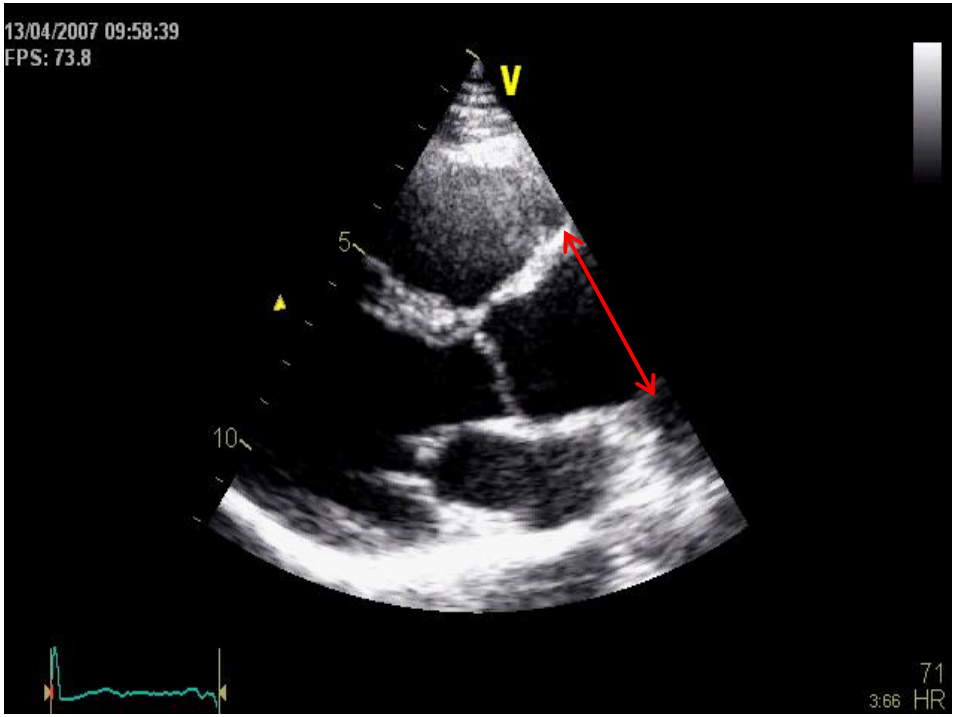
Echo Limitations

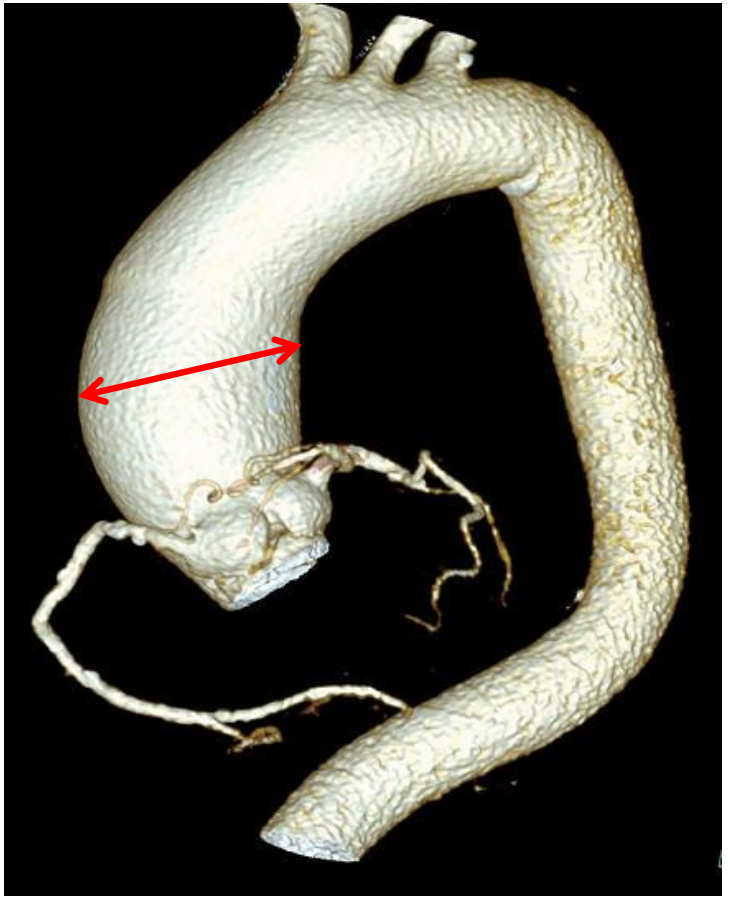
1.- Poor acoustic window



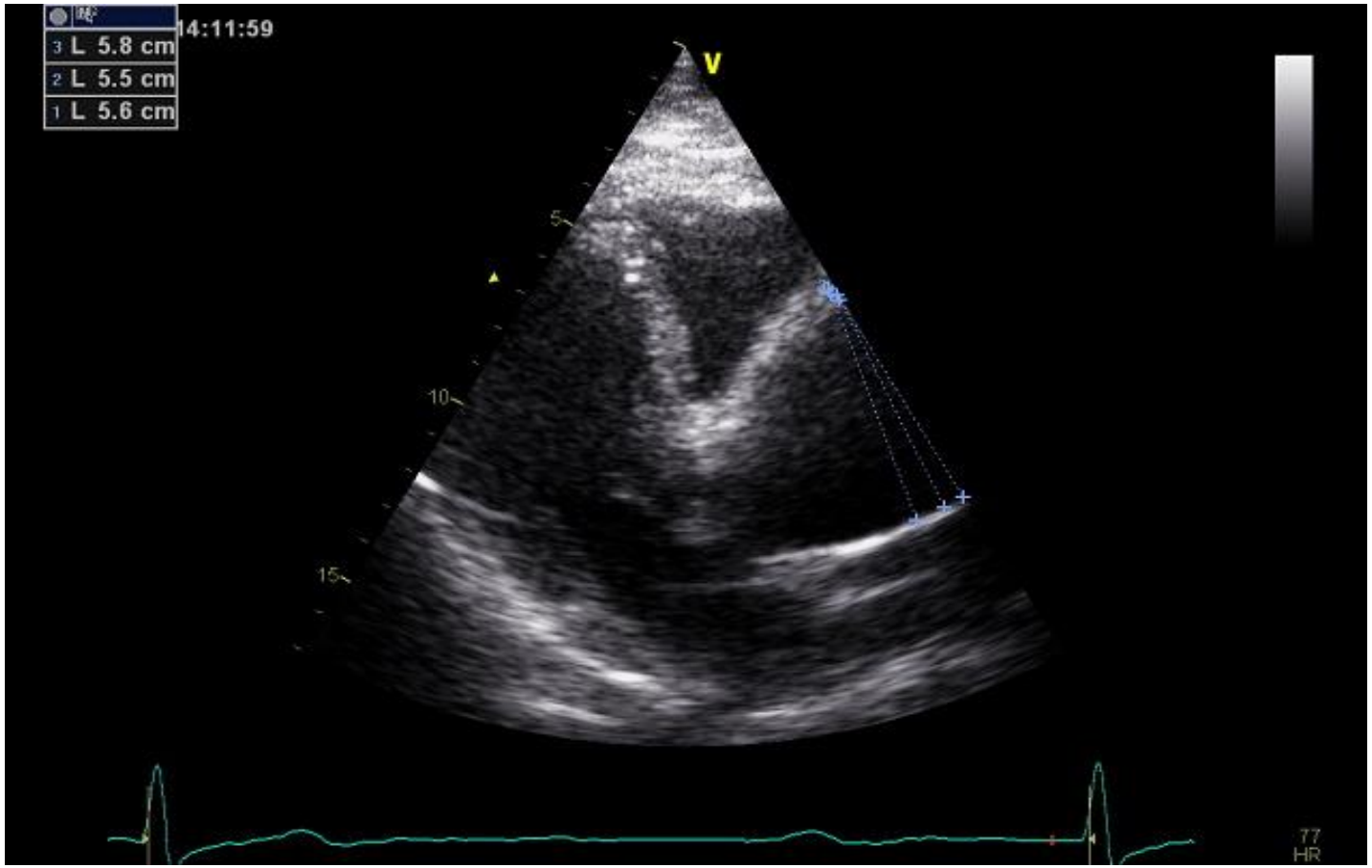
Echo limitations

2.- Visualisation of distal tubular part

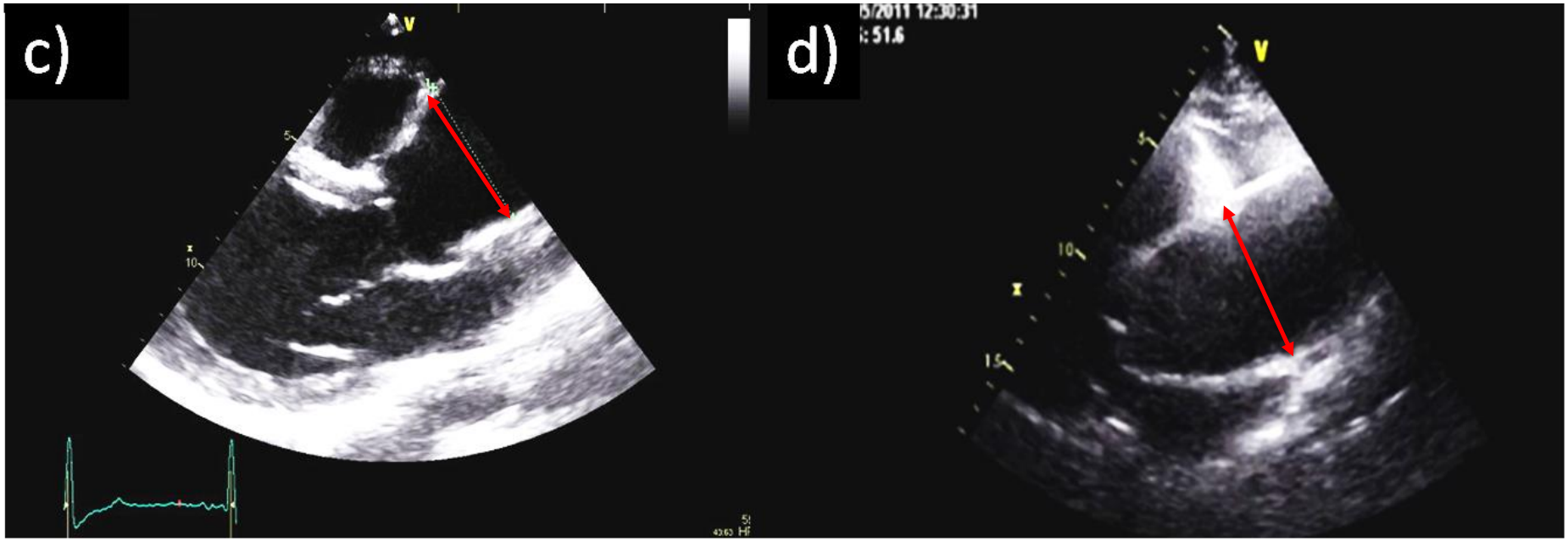




Ascending aorta size by TTE



Echo limitations
2.- Visualisation of distal tubular part



AORTIC DISEASES

ESC GUIDELINES ON THE DIAGNOSIS AND TREATMENT OF AORTIC DISEASES

For more information
www.escardio.org/guidelines

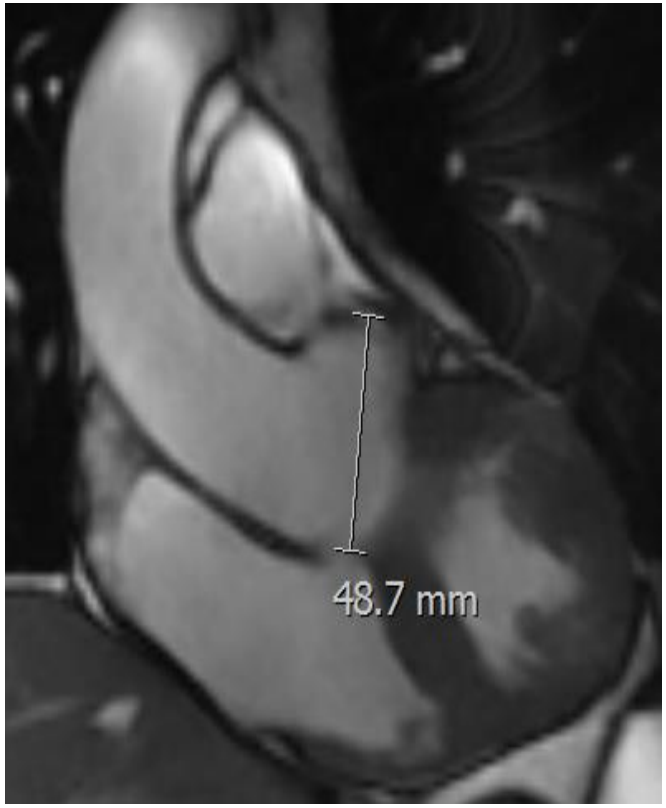
EUROPEAN SOCIETY OF CARDIOLOGY®

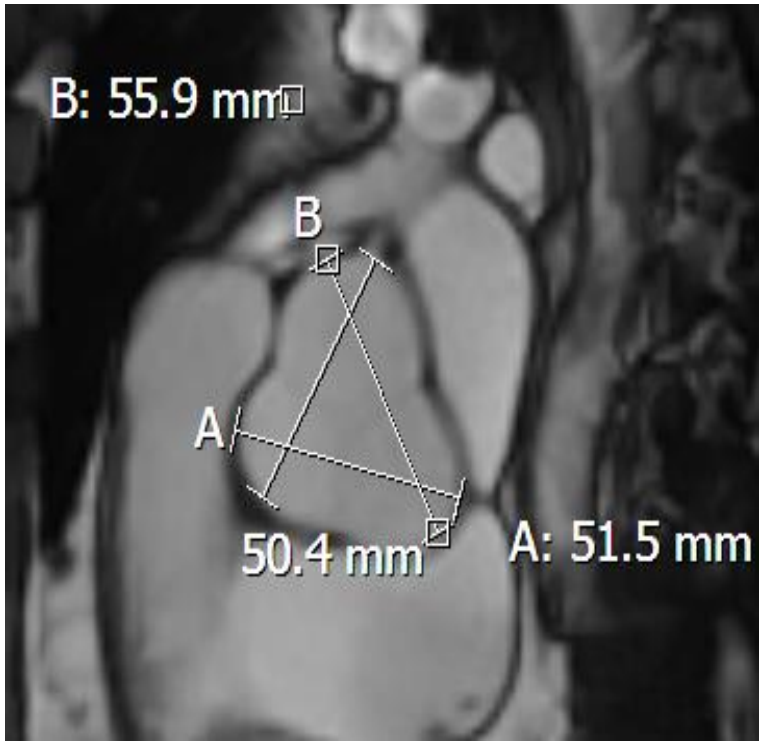
5.1 Indication for intervention for ascending and arch aortic aneuryms

- Surgery is indicated in patients who have aortic root aneurysms with maximal aortic diameter ≥50 mm for patients with Marfan syndrome (Class I C).
- Surgery should be considered in patients who have aortic root aneurysm with maximal ascending aortic diameter:
  - ≥45 mm for patients with Marfan syndromes with risk factors (family history of aortic dissection and/or aortic diameter increase >3 mm/year
  - ≥50 mm for patients with bicuspid valve with risk factors
  - ≥55 mm for patients with no elastopathy (Class IIa C).

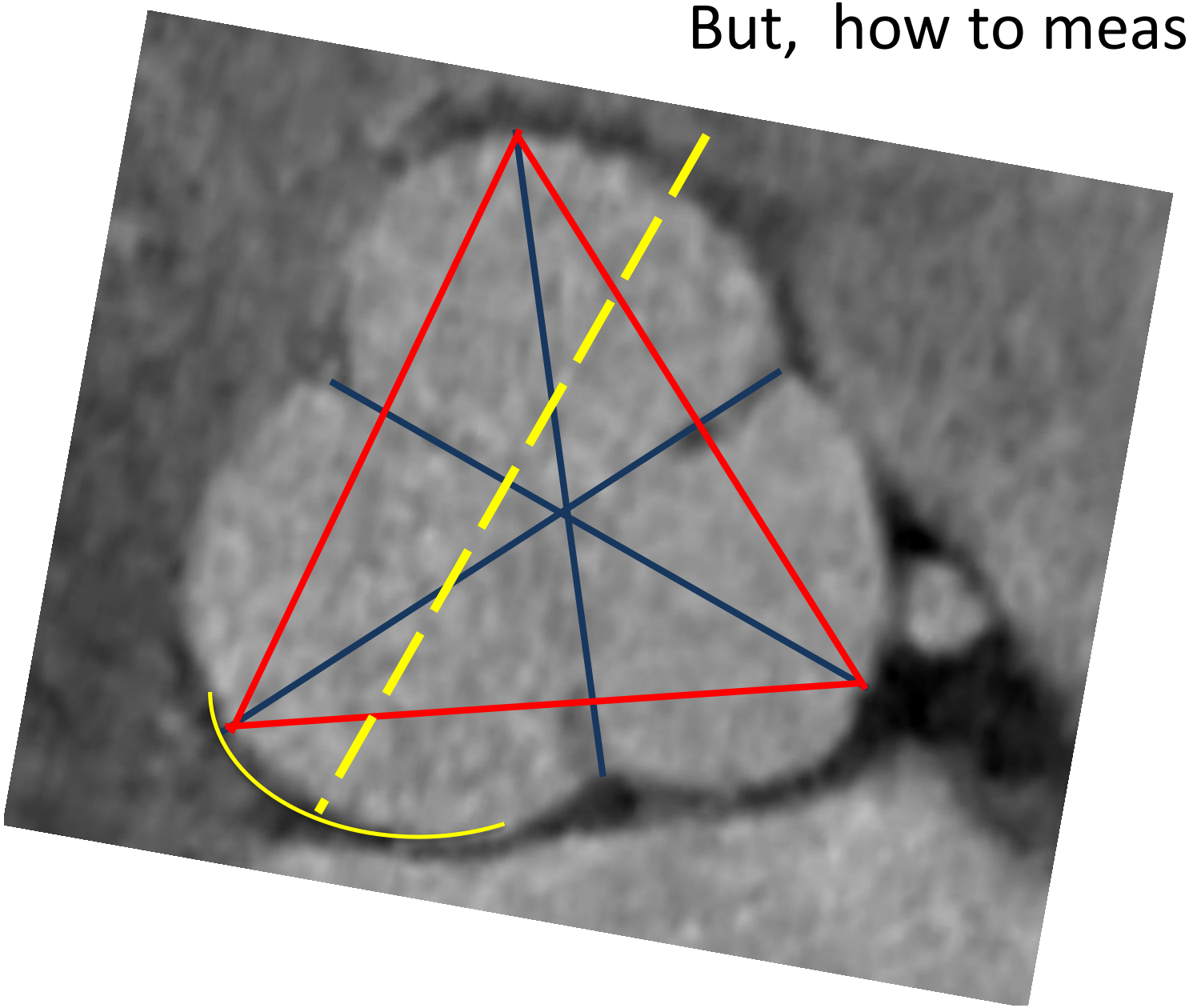
Too stringent?

But, how to measure? Which projection?





But, how to measure?



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CLINICAL INVESTIGATIONS

AORTIC DIMENSIONS

Multimodality Assessment of Ascending Aortic Diameters: Comparison of Different Measurement Methods

José F. Rodríguez-Palomares, MD, PhD, Gisela Teixidó-Tura, MD, PhD, Valentina Galuppo, MD, Hug Cuéllar, MD, Ana Laynez, MD, Laura Gutiérrez, MD, María Teresa González-Alujas, MD, PhD, David García-Dorado, MD, PhD, and Arturo Evangelista, MD, PhD, *Barcelona, Spain*

Conclusions: Aortic root and ascending aortic diameters measured by 2D TTE using the L-L convention showed accurate and reproducible values compared with internal diameters assessed by MDCT or MRI. This approach permits a multimodality follow-up of patients with aortic diseases and avoids disparities in measurements obtained by different conventions. (J Am Soc Echocardiogr 2016;29:819-26.)

Multimodality Assessment of Ascending Aortic Diameters: Comparison of Different Measurement Methods

José F. Rodríguez-Palomares, MD, PhD, Gisela Teixidó-Tura, MD, PhD, Valentina Galuppo, MD, Hug Cuéllar, MD, Ana Laynez, MD, Laura Gutiérrez, MD, María Teresa González-Alujas, MD, PhD, David García-Dorado, MD, PhD, and Arturo Evangelista, MD, PhD, *Barcelona, Spain*

140 patients
< 1s week
TTE- CT
TTE- MRI

Supplemental Table 4 Differences between aortic diameters measured by echocardiography using the three different conventions (I-I, L-L, and O-O) versus MDCT and MRI using two different conventions (I-I and O-O) at different aortic levels

	2D TTE I-I	2D TTE L-L	2D TTE O-O	2D TTE I-I	2D TTE L-L	2D TTE O-O
MDCT		MDCT I-I			MDCT O-O	
NCC-commissure	−2.5 ± 2.2*	0.3 ± 2.5†	2.8 ± 2.3*	−2.7 ± 2.2*	−0.6 ± 2.5†	2.2 ± 2.3*
RCC-commissure	−1.6 ± 2.3*	0.3 ± 2.2†	3.1 ± 2.7*	−3.4 ± 1.9*	−0.7 ± 2.9†	2.5 ± 3.2*
LCC-commissure	−2.1 ± 2.6*	0.4 ± 2.5†	3.2 ± 2.9*	−3.6 ± 2.4*	−0.9 ± 2.6†	2.3 ± 2.1*
STJ AP	−2.6 ± 1.3*	0.6 ± 1.8†	2.9 ± 2.4*	−3.9 ± 1.8*	−1.2 ± 2.6†	2.6 ± 1.9*
AA AP	−2.4 ± 2.1*	−0.5 ± 2.6†	2.5 ± 2.6*	−4.2 ± 2.6*	−1.3 ± 2.7†	2.2 ± 2.7*
MRI		MRI I-I			MRI O-O	
NCC-commissure	−2.3 ± 1.8*	0.5 ± 1.7†	4.8 ± 1.9*	−2.5 ± 2.2*	0.7 ± 2.5†	2.8 ± 2.6*
RCC-commissure	−1.5 ± 1.6*	0.6 ± 1.4†	4.7 ± 2.4*	−2.9 ± 2.9*	1.6 ± 2.7†	1.9 ± 2.5*
LCC-commissure	−2.1 ± 1.5*	0.8 ± 1.9†	5.4 ± 1.9*	−2.6 ± 2.3*	1.5 ± 2.3†	2.3 ± 2.2*
STJ AP	−2.4 ± 1.6*	0.4 ± 1.6†	4.1 ± 2.1*	−2.4 ± 1.8*	0.9 ± 1.8†	2.9 ± 1.9*
AA AP	−2.3 ± 1.5*	0.3 ± 1.9†	2.6 ± 1.5*	−2.5 ± 1.6*	1.2 ± 2.2†	3.1 ± 2.5*

LCC, Left coronary cusp.
Data are expressed as mean ± standard deviation.
*$P < .001$.
†$P > .05$.

(J Am Soc Echocardiogr 2016;29:819-26.)

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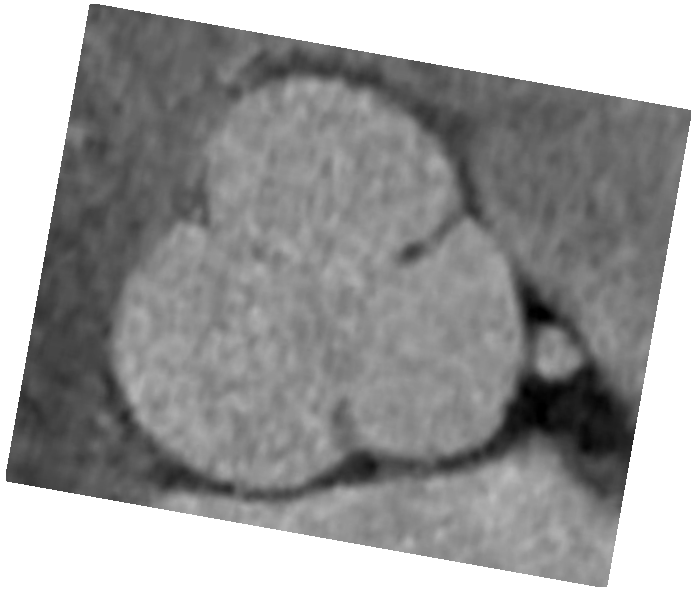
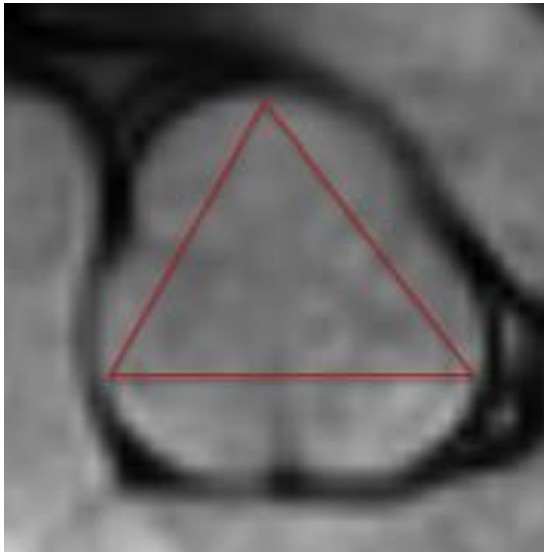
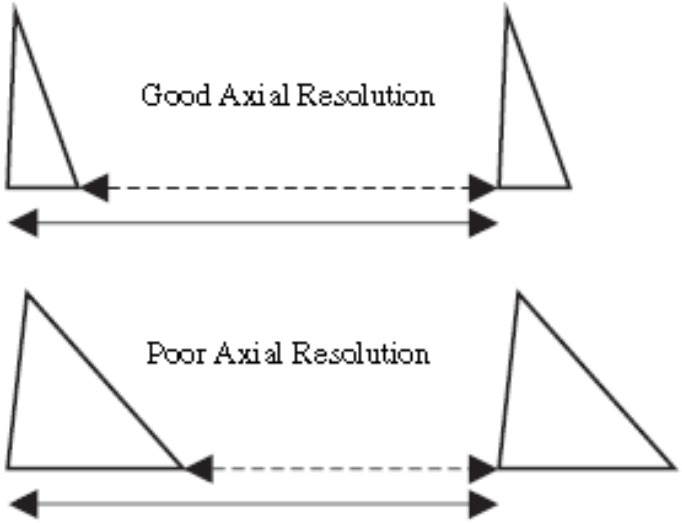
Multimodality Imaging: Spatial Resolution
Aortic Wall Thickness

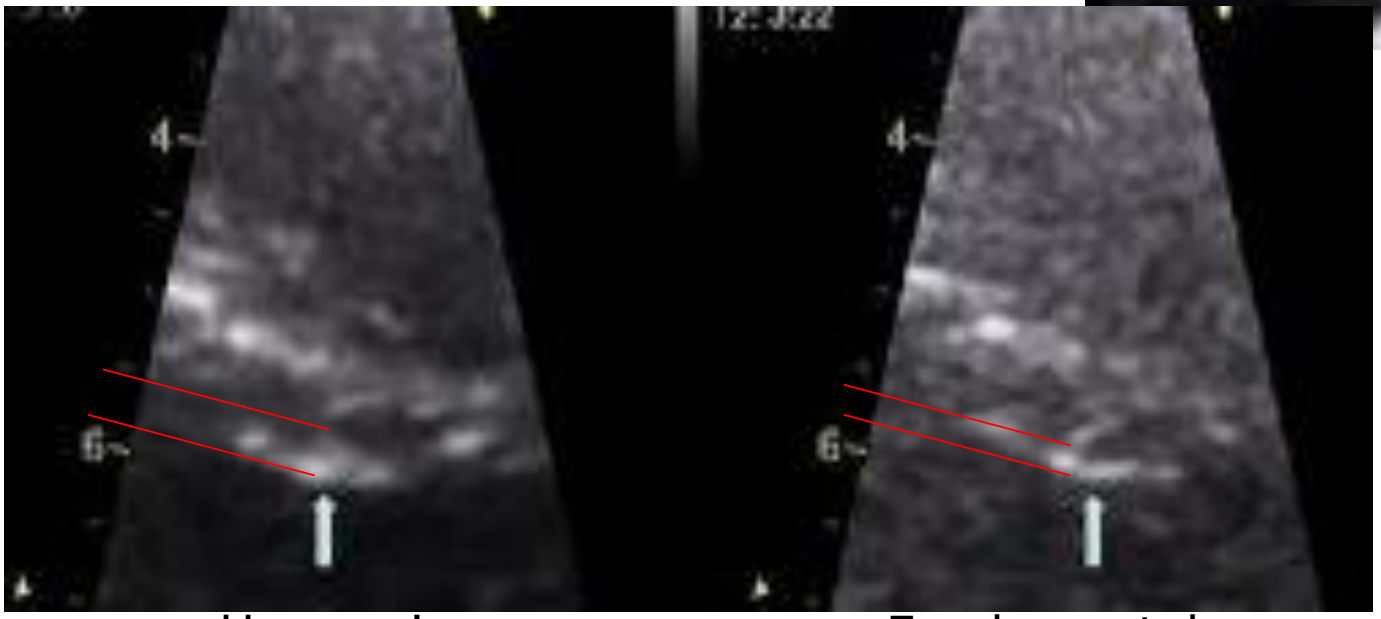




2D TTE	**CT**	**MRI**
F : 1.8±0.7 mm	0.8±0.7 mm	1.4±1.2 mm
H: 3.2±1.6 mm		

Harmonic vs Fundamental



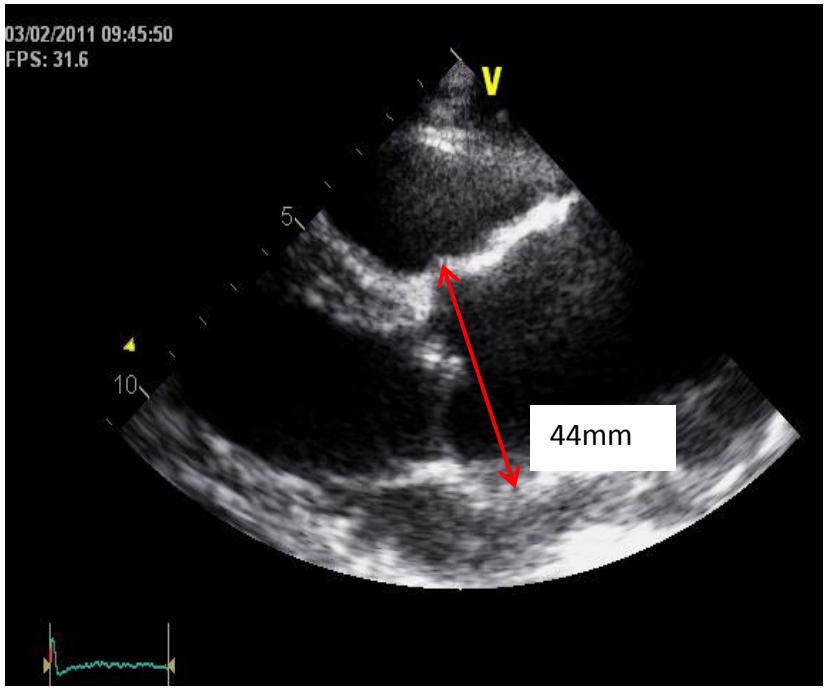


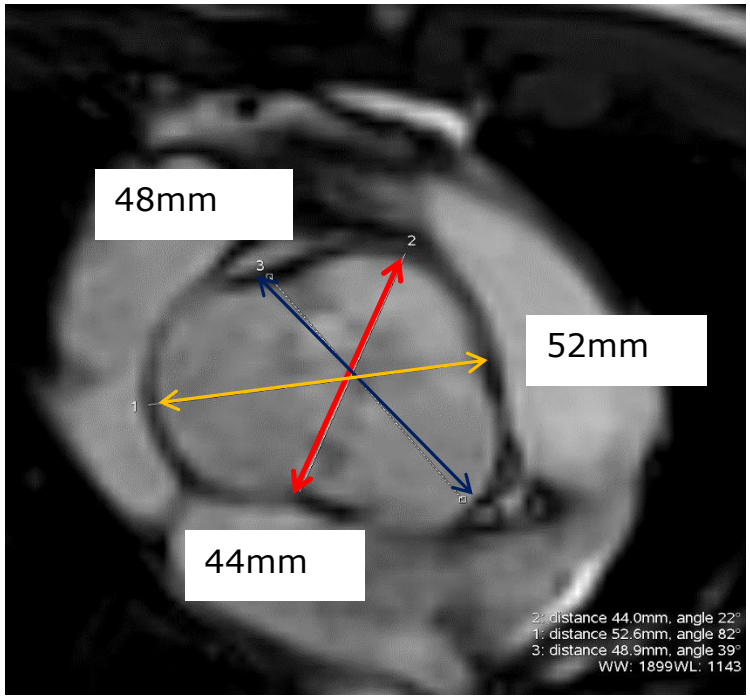
Harmonic

Fundamental

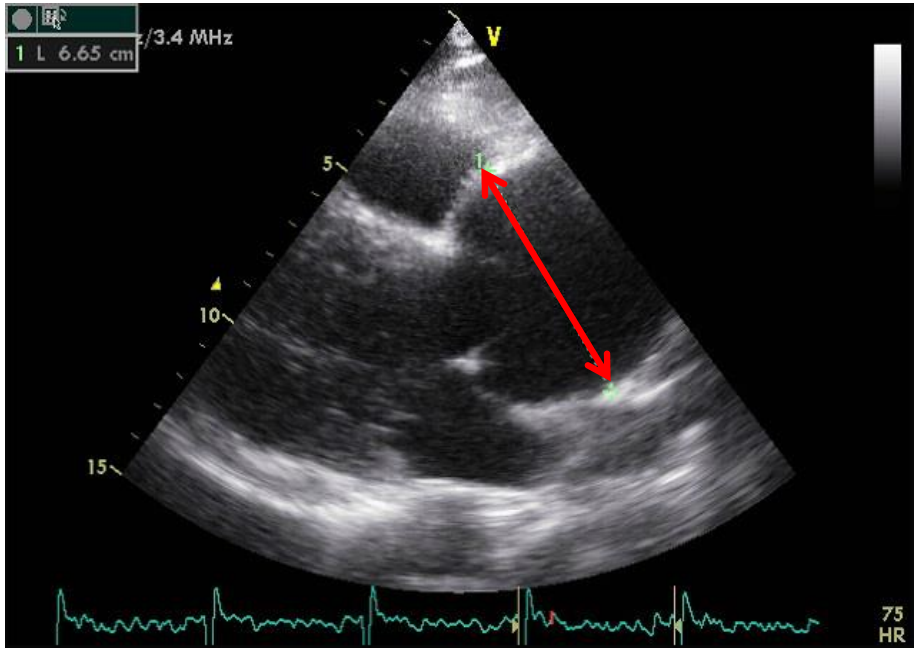
Echo Limitations

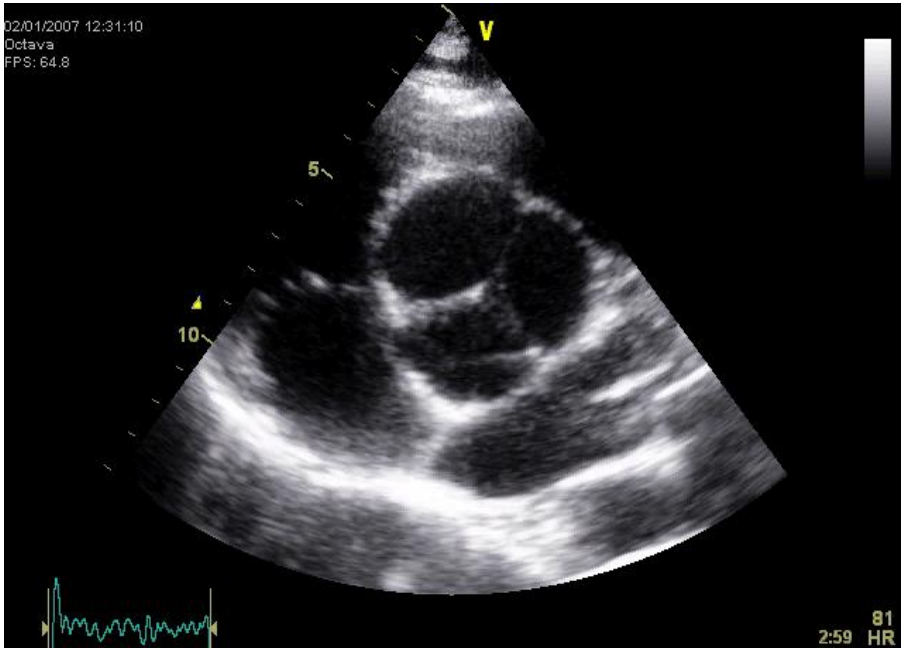
3.- Asymmetry of the aorta



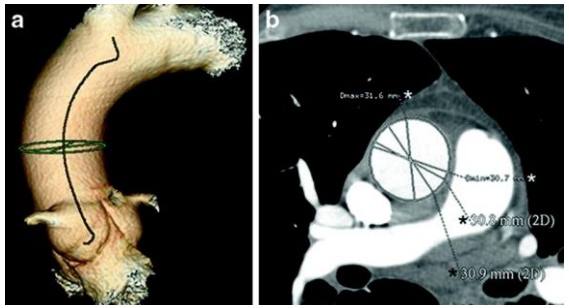


2D-Echo: maximum aortic root diameter





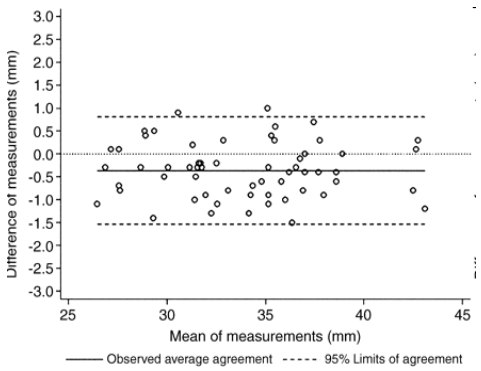
Maximum Diameter Reproducibility
What is a real diameter change?



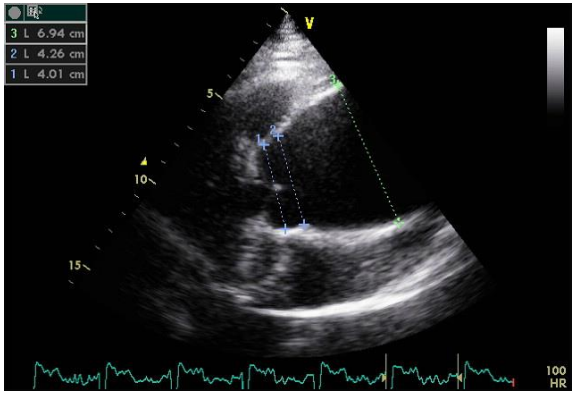
Variability of ascending aorta diameter measurements as assessed with electrocardiography-gated multidetector computerized tomography and computer assisted diagnosis software

Tri-Linh Christian Lu, Elena Rizzo, Pedro Manuel Marques-Vidal, Ludwig Karl von Segesser, Jamshid Dehmeshki and Salah Dine Qanadli

Interact CardioVasc Thorac Surg 2010;10:217-221; originally published online Nov 2,



2.2 mm



Parameter	SVA Mean difference	SVA ICC	STJ Mean difference	STJ ICC	AA Mean difference	AA ICC
Interobserver variability						
I-I	0.1 ± 1.1†	0.96*	0.5 ± 1.6†	0.93*	0.3 ± 1.4†	0.92*
L-L	0.2 ± 1.3†	0.94*	0.4 ± 1.2†	0.96*	0.5 ± 1.7†	0.95*
O-O	0.3 ± 1.2†	0.95*	0.3 ± 1.2†	0.92*	0.3 ± 1.3†	0.95*
Interacquisition variability‡						
I-I	0.7 ± 1.6†	0.94*	0.7 ± 1.6†	0.93*	1.1 ± 1.9†	0.93*
L-L	0.8 ± 1.7†	0.93*	0.6 ± 1.5†	0.92*	0.8 ± 1.9†	0.92*
O-O	0.7 ± 1.2†	0.92*	0.6 ± 1.3†	0.93*	0.7 ± 1.5†	0.94*

3.4 mm

(J Am Soc Echocardiogr 2015;28:119-82.)

Multimodality Imaging of Diseases of the Thoracic Aorta in Adults: From the American Society of Echocardiography and the European Association of Cardiovascular Imaging

Endorsed by the Society of Cardiovascular Computed Tomography and Society for Cardiovascular Magnetic Resonance

Steven A. Goldstein, MD, Co-Chair, Arturo Evangelista, MD, FESC, Co-Chair, Suhny Abbara, MD, Andrew Arai, MD, Federico M. Asch, MD, FASE, Luigi P. Badano, MD, PhD, FESC, Michael A. Bolen, MD, Heidi M. Connolly, MD, Hug Cuéllar-Calàbria, MD, Martin Czerny, MD, Richard B. Devereux, MD, Raimund A. Erbel, MD, FASE, FESC, Rossella Fattori, MD, Eric M. Isselbacher, MD, Joseph M. Lindsay, MD, Marti McCulloch, MBA, RDCS, FASE, Hector I. Michelena, MD, FASE, Christoph A. Nienaber, MD, FESC, Jae K. Oh, MD, FASE, Mauro Pepi, MD, FESC, Allen J. Taylor, MD, Jonathan W. Weinsaft, MD, Jose Luis Zamorano, MD, FESC, FASE, Contributing Editors: Harry Dietz, MD, Kim Eagle, MD, John Elefteriades, MD, Guillaume Jondeau, MD, PhD, FESC, Hervé Rousseau, MD, PhD,

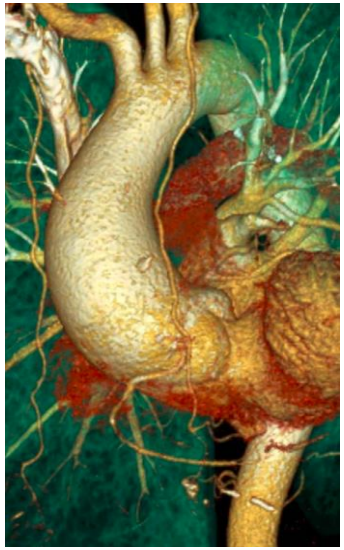


Table 17 Recommendations for choice of imaging modality for TAA

Modality	Recommendation	Advantages	Disadvantages
CT	First-line	• First-line technique for staging, surveillance • Contrast-enhanced CT and MRI very accurate for measuring size of all TAAs (superior to echocardiography for distal ascending aorta, arch, and descending aorta) • All segments of aorta and aortic branches well visualized	• Use of ionizing radiation and ICM • Cardiac motion can cause imaging artifacts
MRI	Second-line	• Ideal technique for comparative follow-up studies • Excellent modality in stable patients • Preferred for follow-up for younger patients • Avoids ionizing radiation • Can image entire aorta	• Examination times longer than CT • Benefits from patient cooperation (breath hold) • Limited in emergency situations in unstable patients and patients with implantable metallic devices • Benefits from gadolinium
TTE	Second-line	• Usually diagnostic for aneurysms effecting aortic root • Useful for family screening • Useful for following aortic root disease • Excellent reproducibility of measurements • Excellent for AR, LV function	• Distal ascending aorta, arch, and descending aorta not reliably imaged
TEE	Third-line	• Excellent for assessment of AR mechanisms • Excellent images of aortic root, ascending aorta, arch, and descending thoracic aorta	• Less valuable for routine screening or serial follow-up (semi-invasive) • Distal ascending aorta may be poorly imaged • Does not permit full visualization of arch vessels • Limited landmarks for serial examinations

Imaging aortic aneurysmal disease

Arturo Evangelista

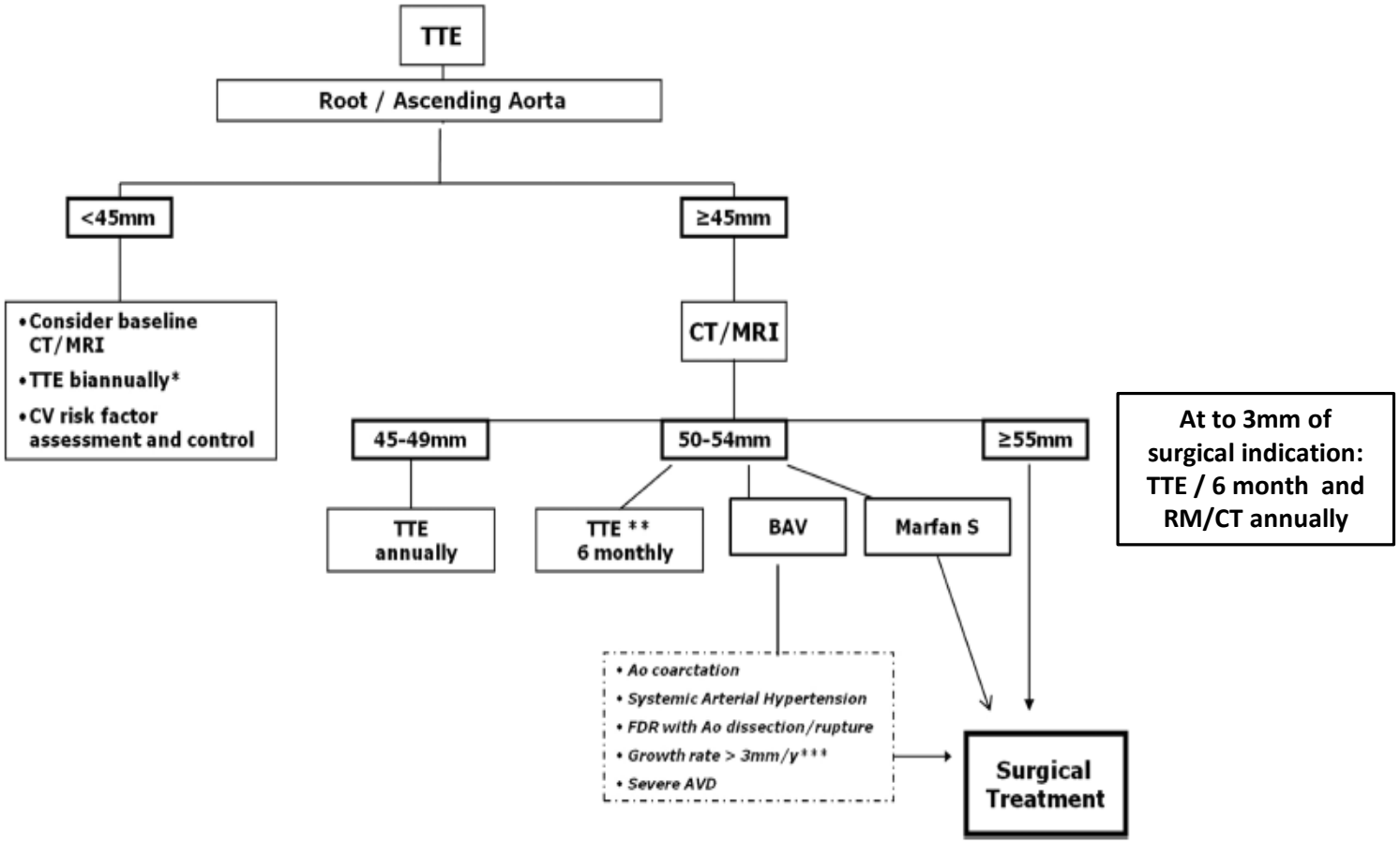


Figure 6 Proposed algorithm for the surveillance and surgical indication work-up of ascending aorta dilation. *When aortic valve disease does not require more frequent study. **When transthoracic echocardiography has similar maximum aortic diameter to CT/MRI; if not, use CT/MRI. ***On repeated measurements using the same ECG-gated imaging technique, measured at the same aorta level with side-by-side comparison.

Ideal follow-up by imaging techniques

Conclusions

- TTE is the primary imaging tool for the initial diagnosis and serial follow-up of aorta dilation, mainly when proximal aorta segments are involved.
- The main limitation of TTE is image quality, mainly in patients with chest deformities, emphysema, etc
- At the time of initial diagnosis of aortopathy, CT or MRI is generally recommended to confirm that the aorta size is not underestimated by TTE due to asymmetrical dilation of the aorta and to rule out involvement of other aorta segments.

Ideal follow-up by imaging techniques Conclusions

- TTE is useful in the follow-up of aorta size provided agreement with other imaging techniques is good.
- When AA diameters are close to indicating surgery (50 mm) CT, and particularly MRI, should be used to improve measurement accuracy. Similarly, either of the techniques should be used when echo diameters have increased > 3mm at the annual follow-up.
- Measurements should be taken using the same imaging protocol. When changes may determine surgical decision, side-by- side comparison among diameters should be made.