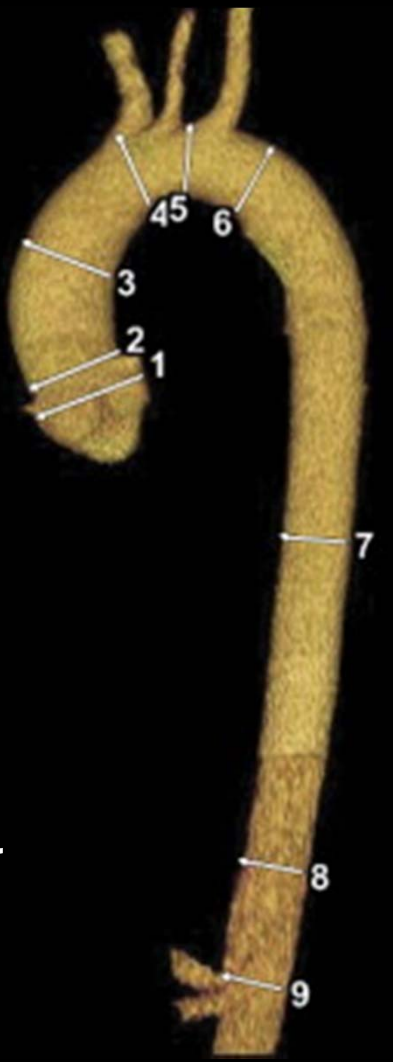
Comprehensive Assessment of Aorta with TEE

Kyung Hee University Hospital

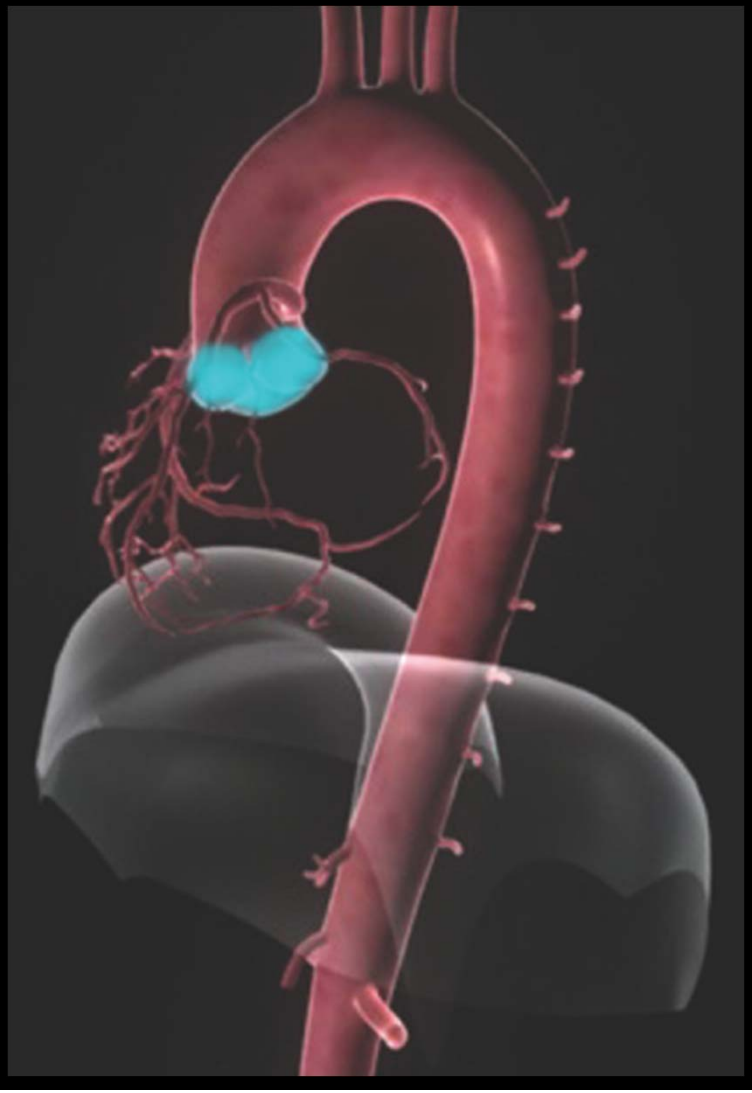
Woo-Shik Kim

ANATOMY OF THE AORTA

1) Aortic root
2) Sinotubular junction
3) Ascending aorta
4) Aortic arch
5) Isthmus and Descending aorta
6) Abdominal aorta



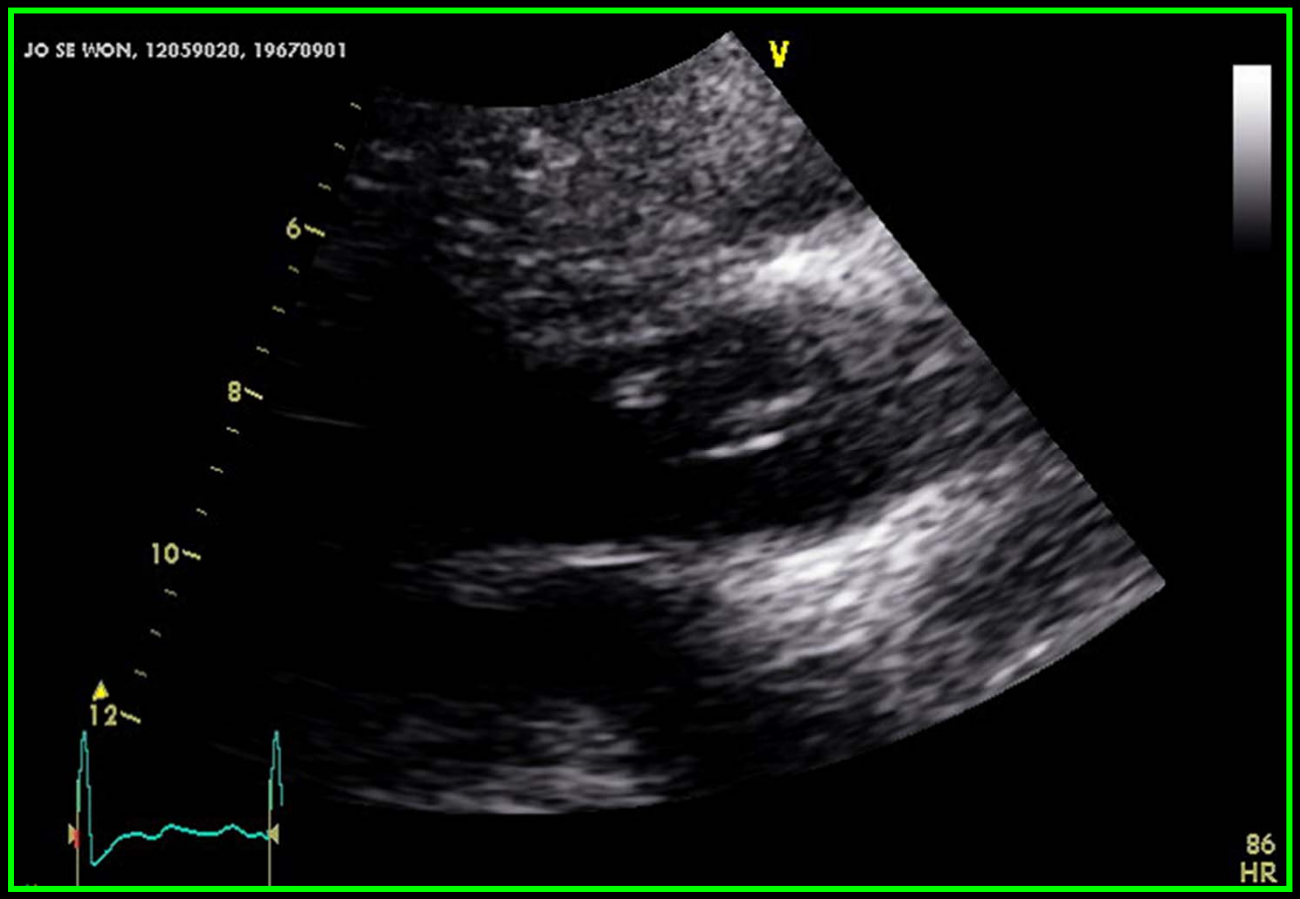
Aortic Root



- The aortic root is the segment of the aorta from the aortic valve annulus to the sinotubular junction, including principally the sinuses of Valsalva.

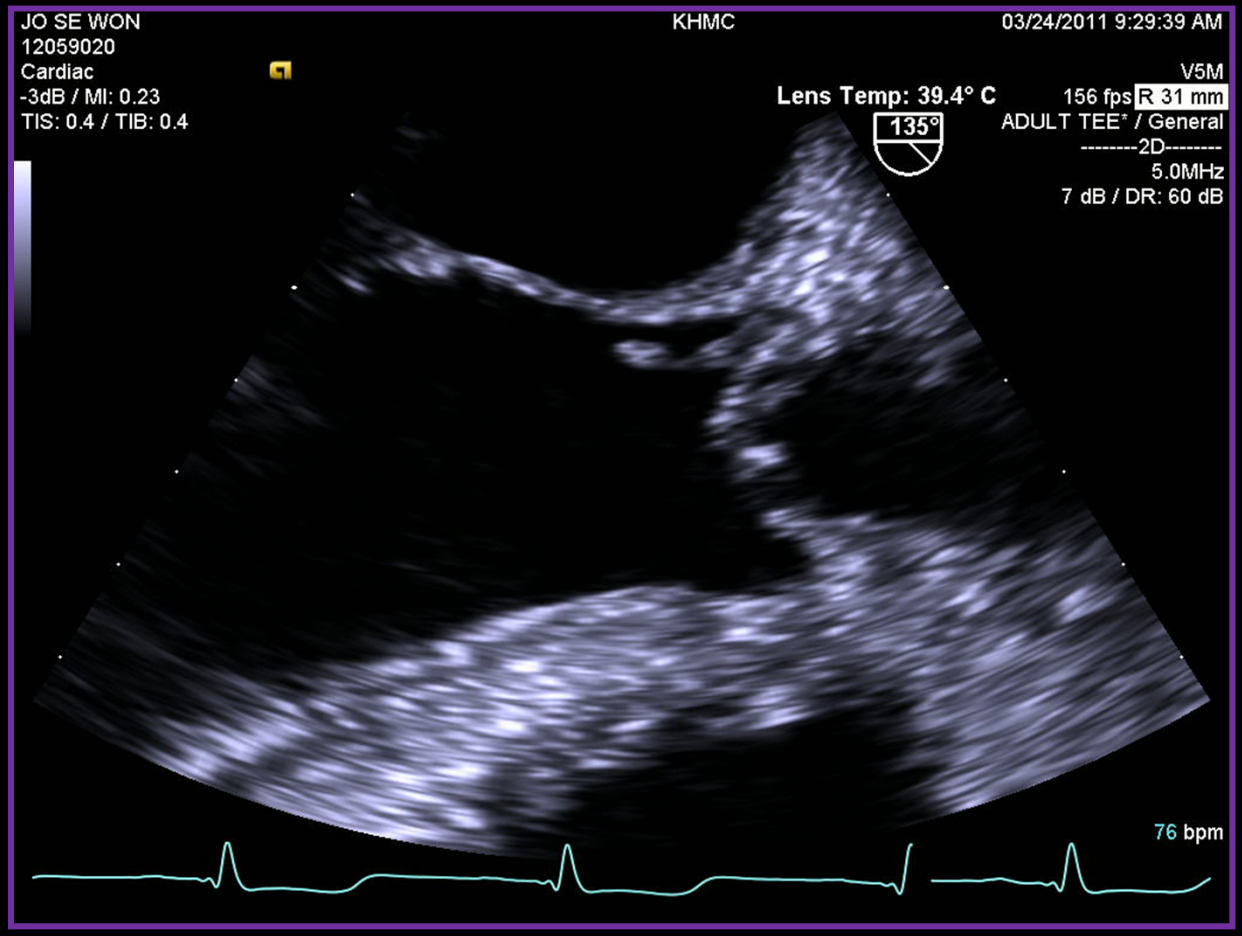
- Normal diameter = 2.9 ± 0.4 cm

Aortic Root



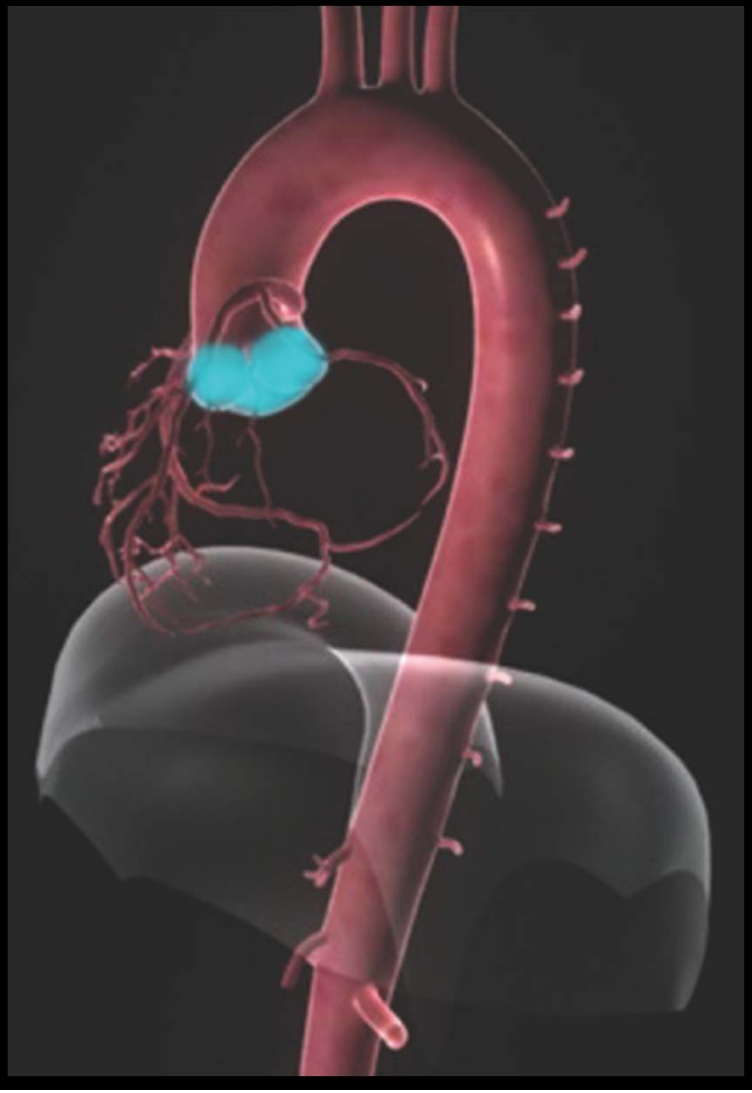
The aortic root is usually well seen by transthoracic echocardiography (TTE)

Aortic Root



Transesophageal echocardiography (TEE) affords superior detail in most cases.

Aortic Root

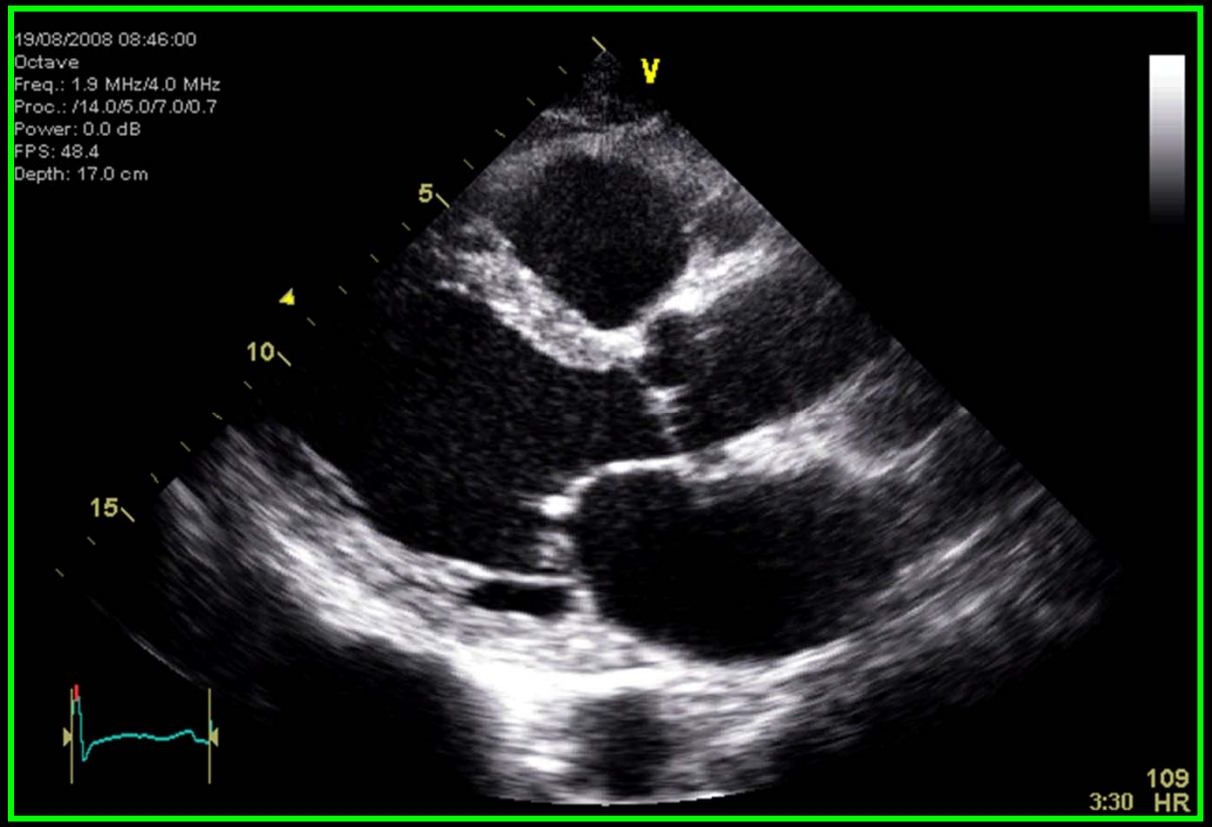


The most common consequence of disease of the aortic root is valve function.

Sinotubular Junction

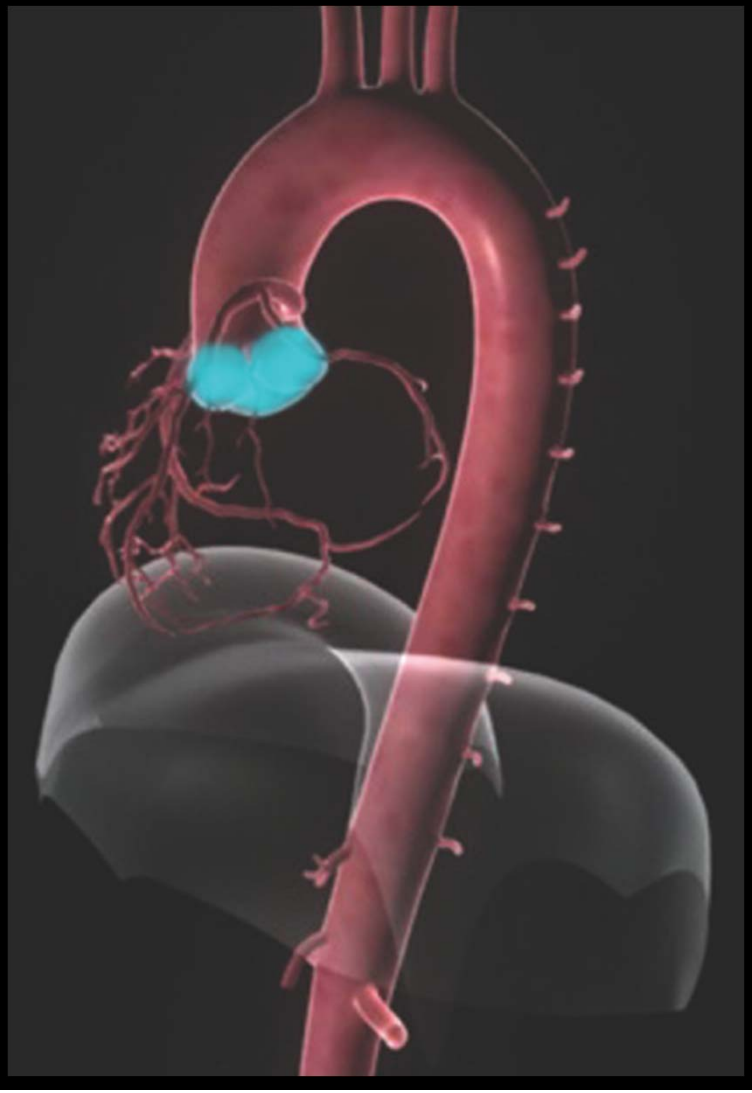
- The sinotubular junction is normally a well-defined site at which the rounded and wider sinuses of Valsalva join the narrower tubule-shaped ascending aorta.
- Normal diameter = 2.6 ± 0.3 cm

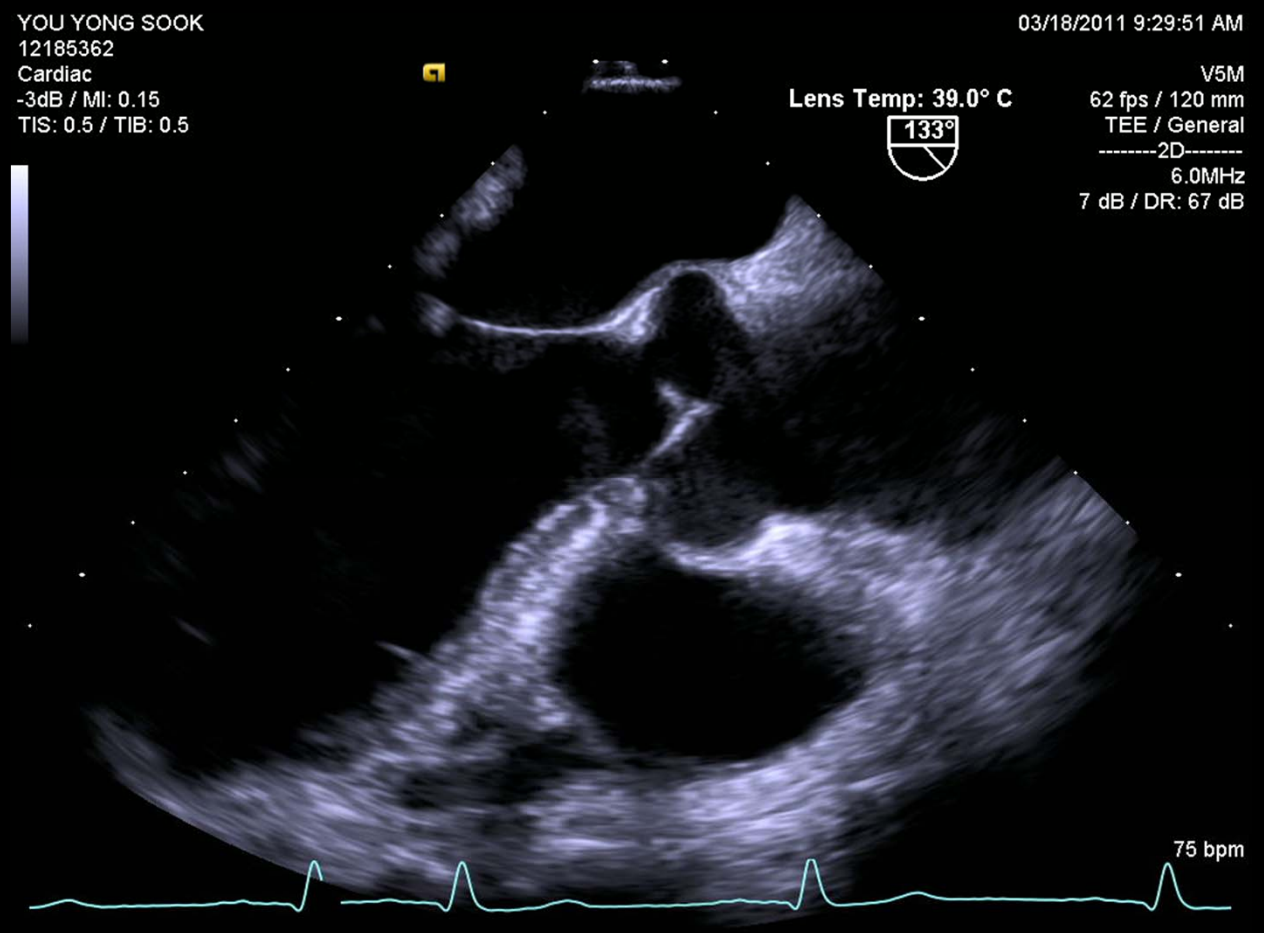
Sinotubular Junction



The sinotubular junction is usually well seen by TTE.

Sinotubular Junction





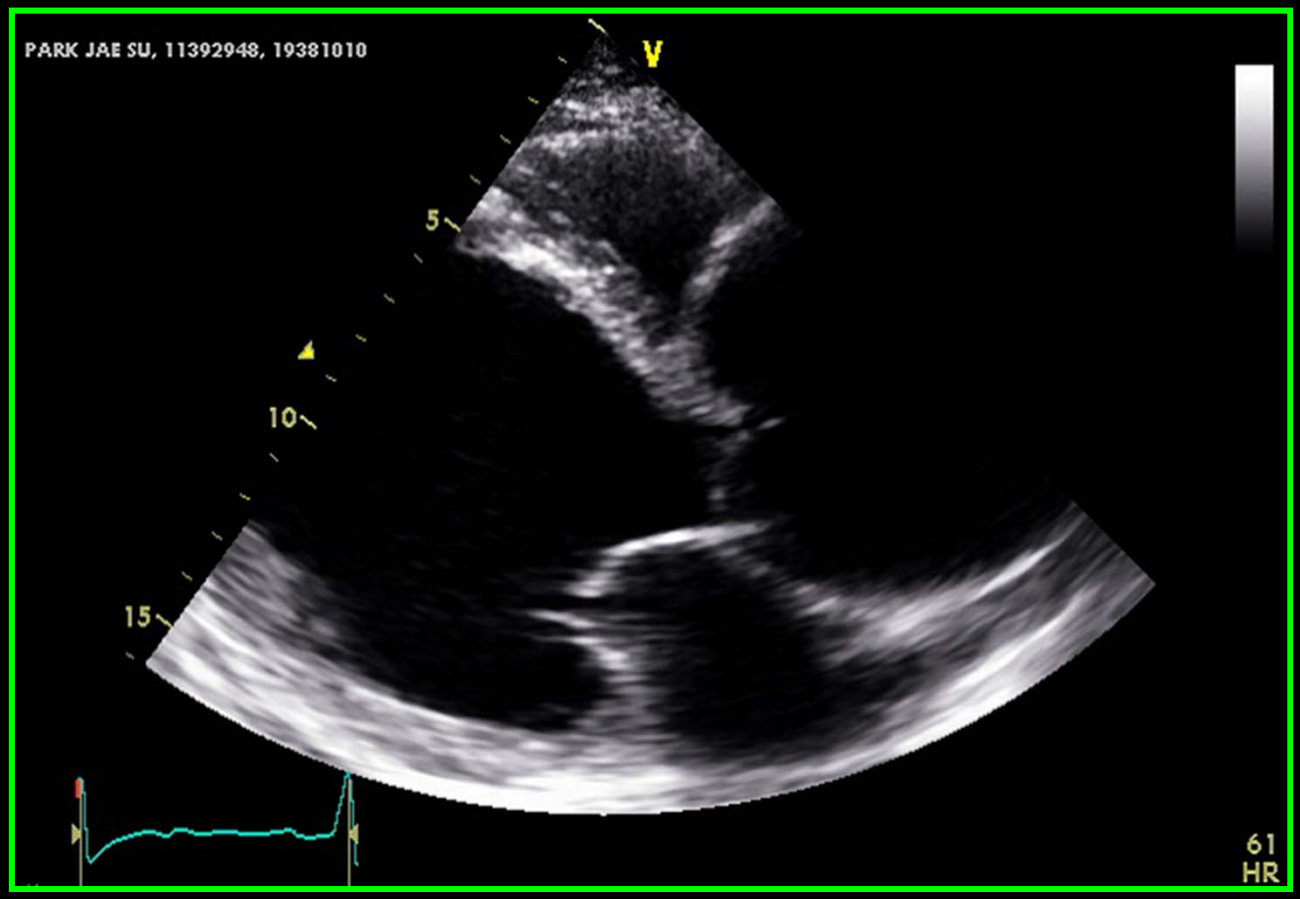
TEE affords superior detail in most cases.

Sinotubular Junction

Effacement (erasing or blurring) of the usually well defined sinotubular junction suggests annuloarotic ectasia, an often marfanoid type of pathology.

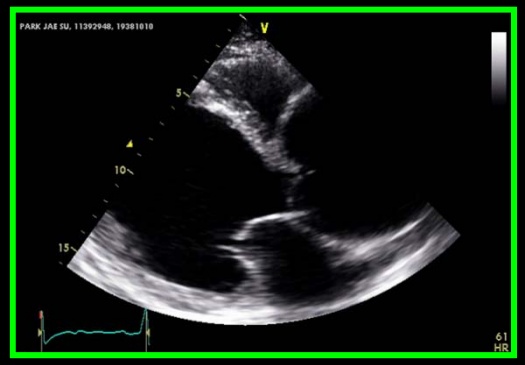
Ascending aortic aneurysm

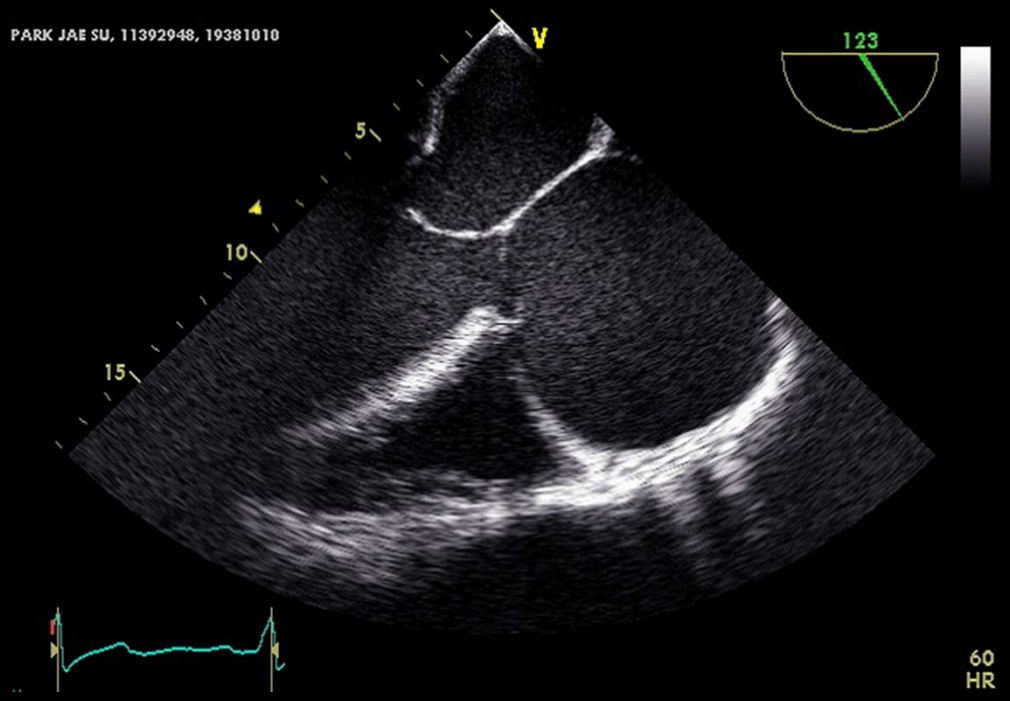
An aneurysm is a dilatation of the aorta to 50% or more above normal size. These often occur in combination with AV pathology.



Ascending aortic aneurysm

Conversely, aortic dilatation that involves the sinotubular junction is a common cause of AV regurgitation.





In this situation it is important to differentiate between normal and abnormal aortic leaflet morphology, as the former may be suitable for an AV sparing procedure.

Thoracic Aortic Aneurysms

The natural history of aortic aneurysm is influenced by

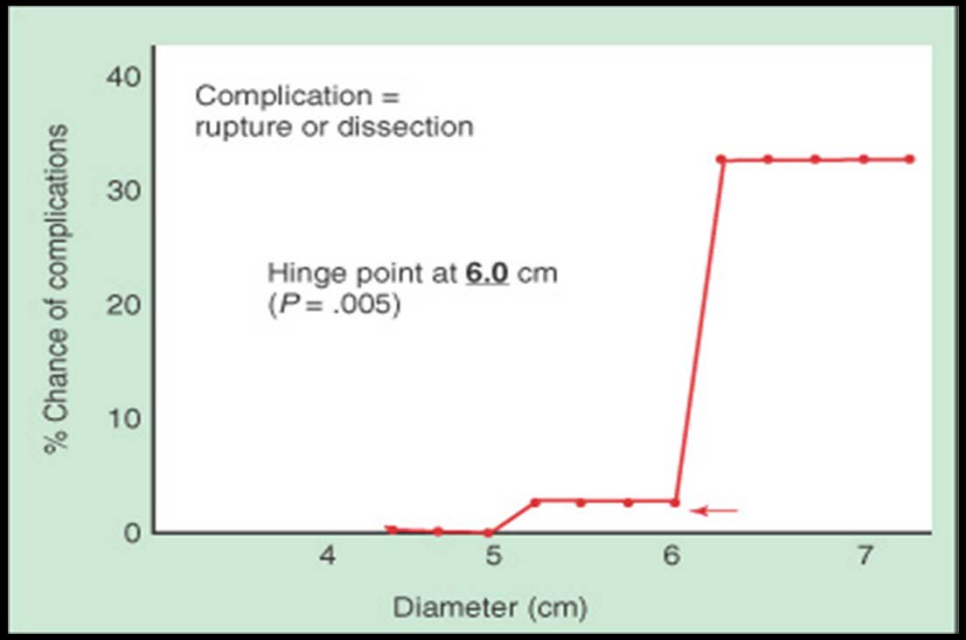
- aneurysm size (diameter),
- rate of expansion,
- location,
- complications (AR, rupture, dissection, thrombosis),
- associated factors (bicuspid aortic valves, concurrent hypertension, hypertension, smoking, COPD),
- underlying causes (Marfan syndrome, Ehlers-Danlos syndrome, infection, inflammation, or atherosclerosis)

Complication Rate is Influenced by Thoracic Aneurysm Diameter

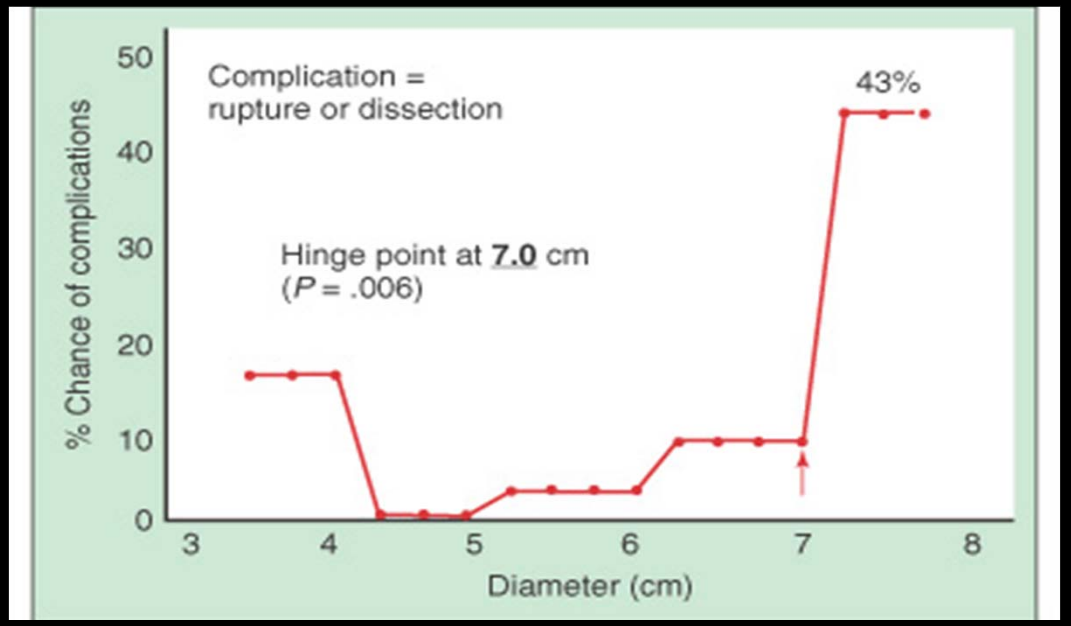
	>3.5 cm	>4.0 cm	>5.0 cm	>6.0 cm
Rupture	0.0 %	0.3 %	1.7 %	3.6 %
Dissection	2.2 %	1.5 %	2.5 %	3.7 %
Death	5.9 %	4.6 %	4.8 %	10.8 %
Any of above	7.2 %	5.3 %	6.5 %	14.1 %

Aortic Aneurysms

Ascending aorta



Descending aorta



- Surgery is performed on aortic aneurysm that measures > 5.5 cm
- Surgery is recommended on descending aortic aneurysm that measures > 6.5 cm

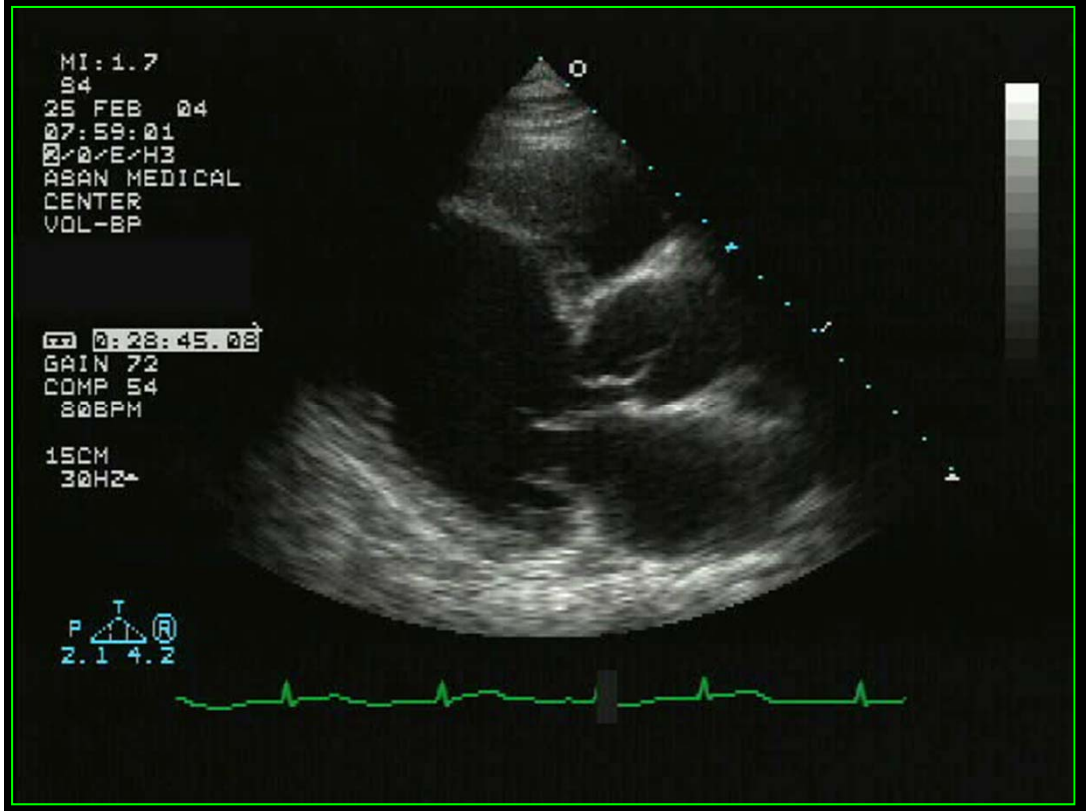
Behçet's Disease

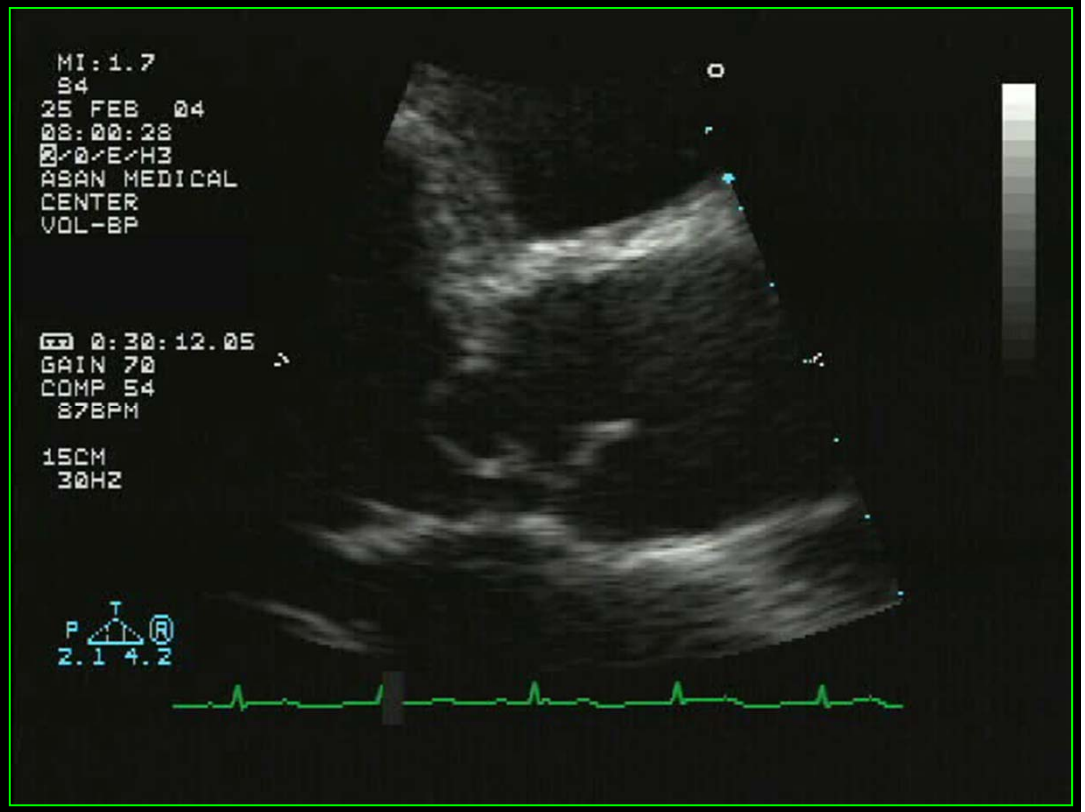
- Recurrent oral & genital ulceration
- Eye lesions, Skin lesions
- Pathergy test

- Vasculitis and aortic aneurysm

- Venous thrombosis
- Bizarre aortic valve with AR

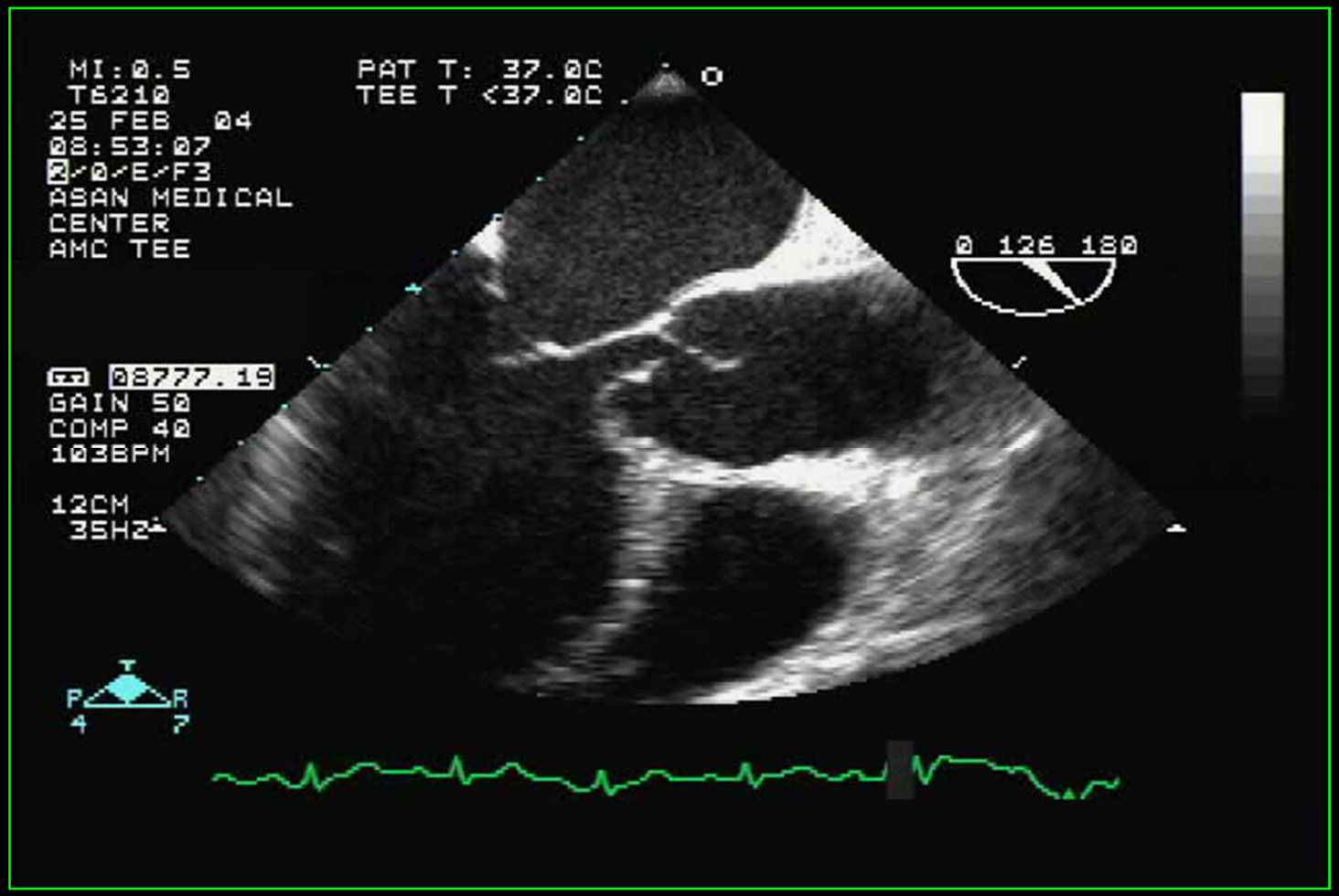
TTE Behçet's Disease





Data source; Korean Society of Echocardiography

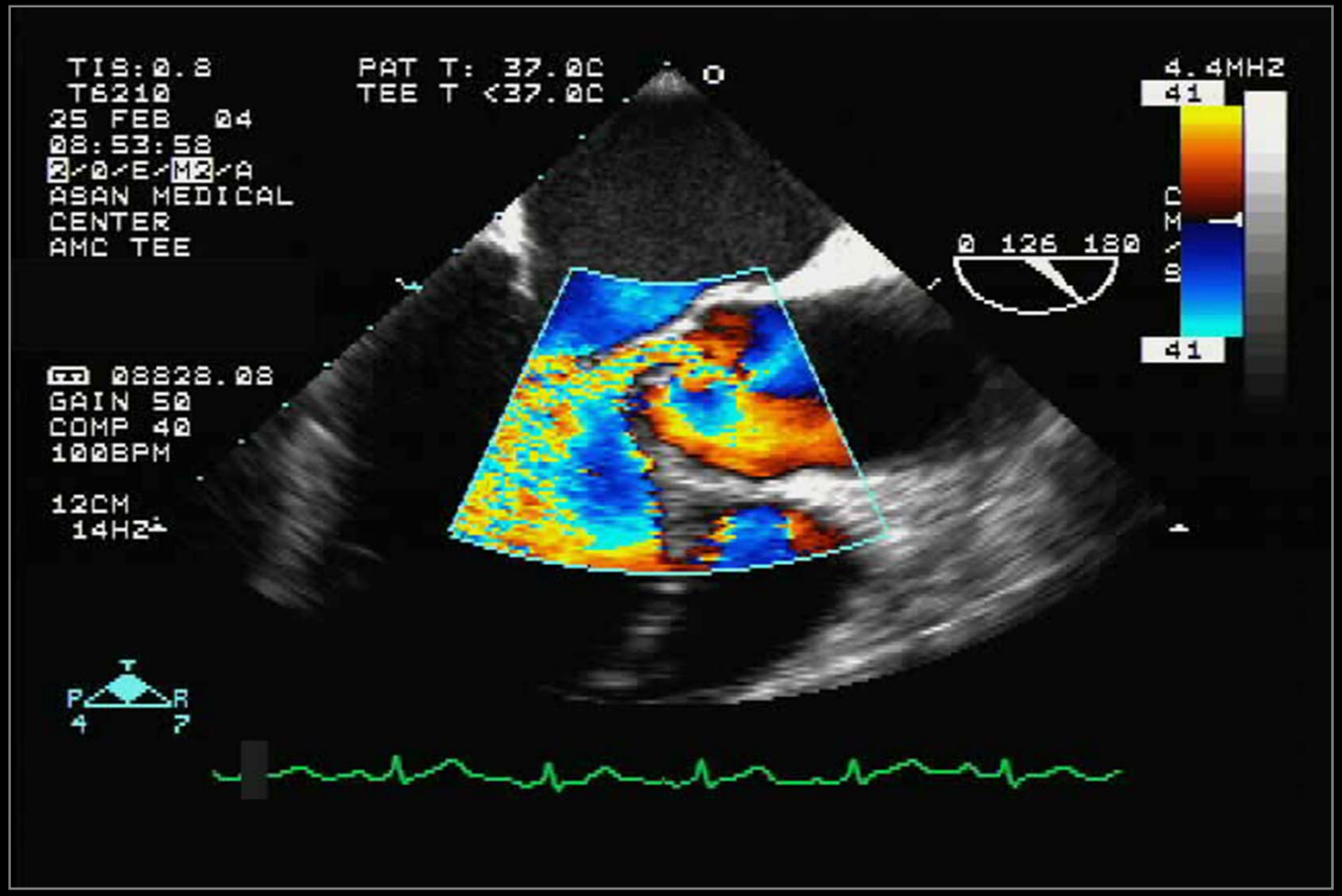
TEE Behçet's Disease



Data source; Korean Society of Echocardiography

TEE

Behçet's Disease



Data source; Korean Society of Echocardiography

Ascending Aorta

- The ascending aorta is the segment of the aorta from the sinotubular junction to the first great arch vessel.
- Normal diameter = 2.6 ± 0.3 cm

Ascending Aorta

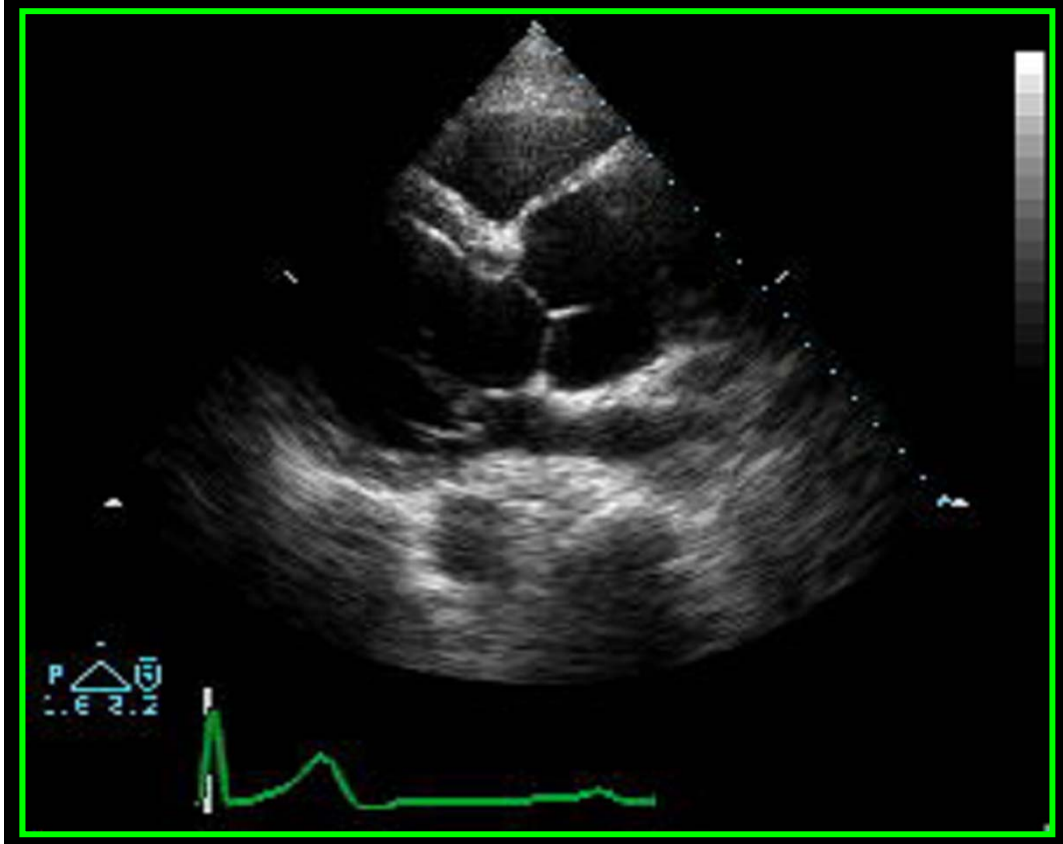
- This segment of the aorta is frequently involved in dissections and aneurysm. Surgical manipulation of the aorta is greatest here, as both the cross-clamp and the afferent bypass cannula insertion sites are within the ascending aorta

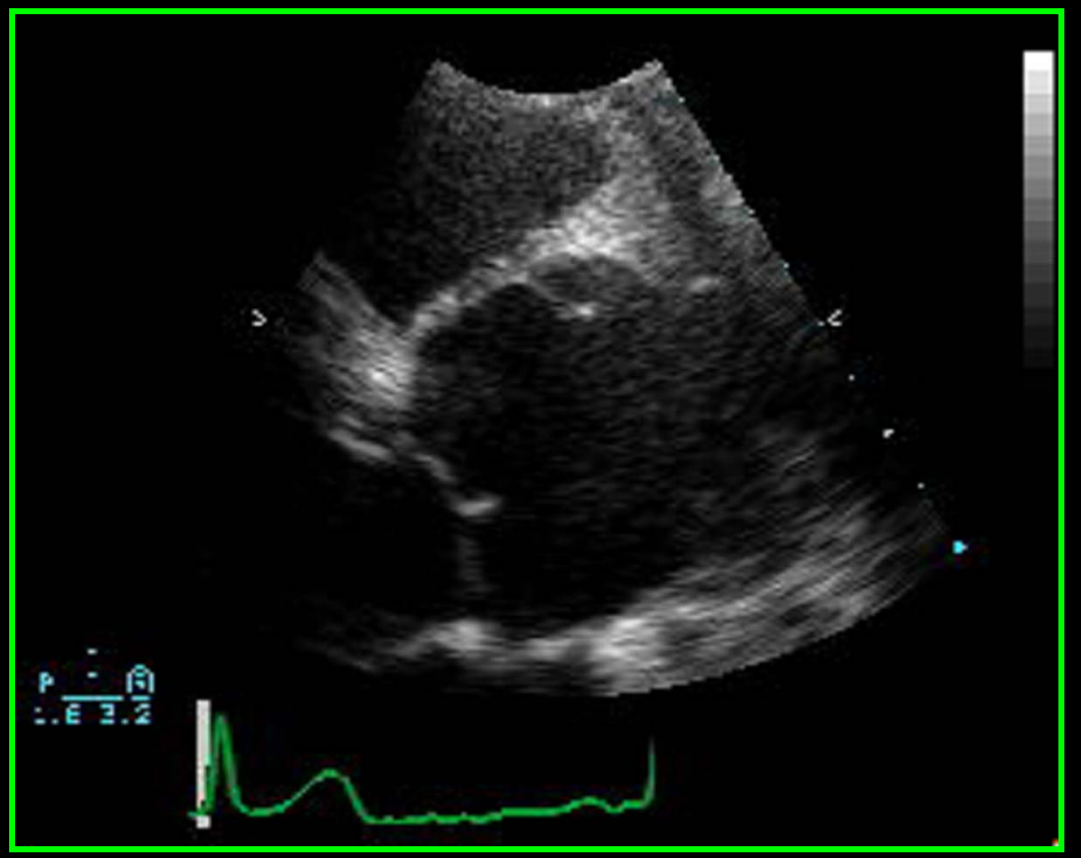
Ascending Aorta

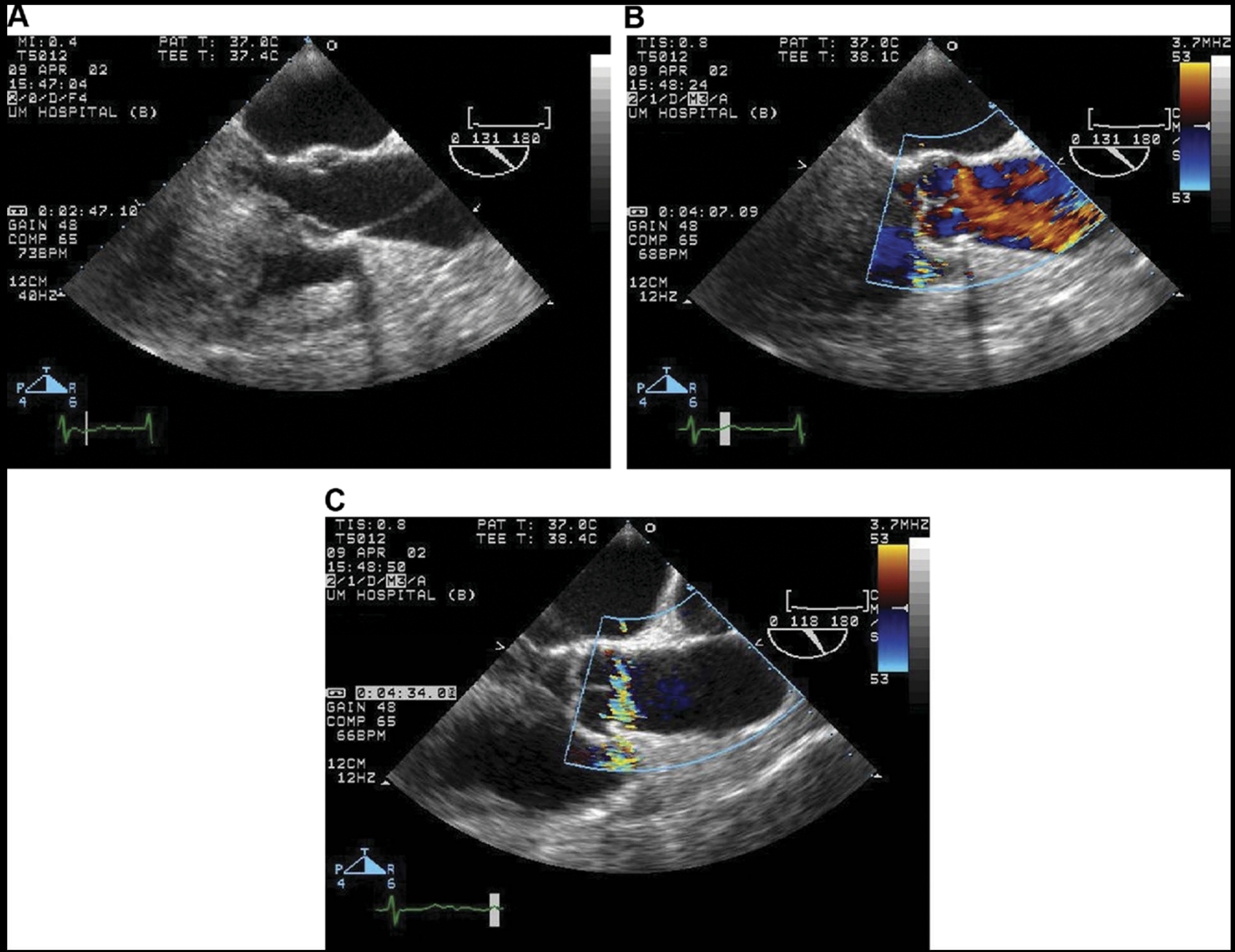
The ascending aorta is less well seen by TTE, and the best depiction of it usually requires higher parasternal views and often high right parasternal views. Artifact over this segment of the aorta are a usual problem for TTE.

Ascending Aorta

TEE affords superior detail in almost all cases but often generates artifacts over this segment of the aorta. It visualizes a variable amount of the ascending aorta, depending on the course of the esophagus and the trachea and right mainstem bronchus.



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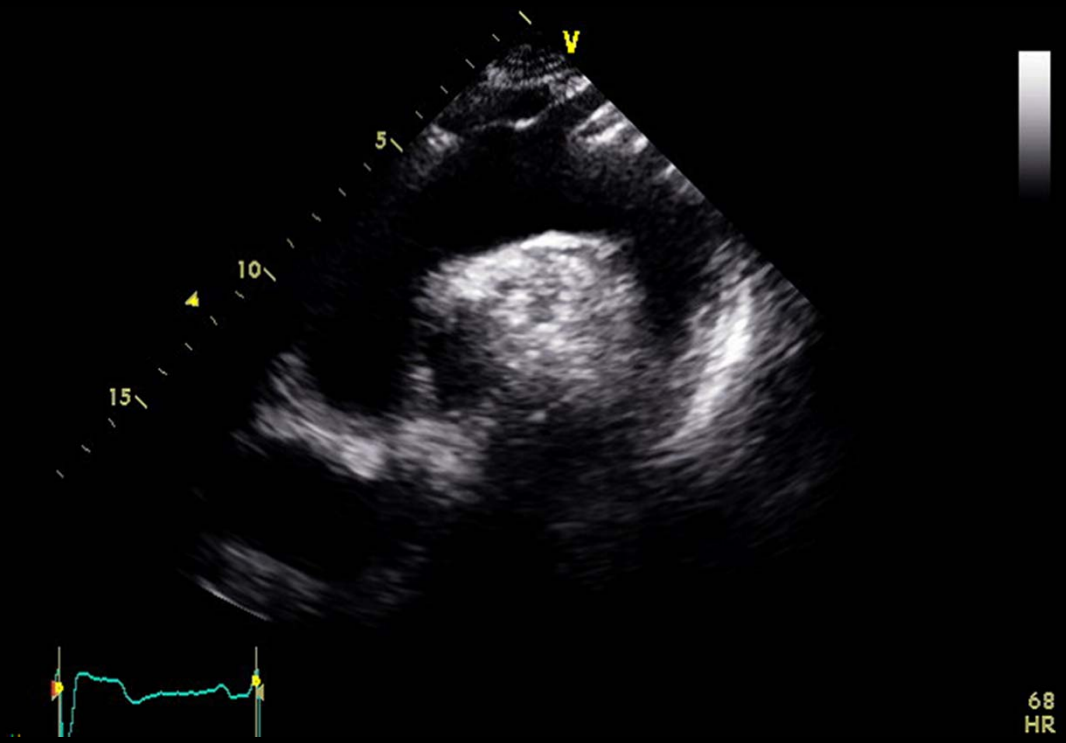
Aortic Arch

The aortic arch is the transverse portion of the aorta from the first arch vessel to the left subclavian artery ostium. The aortic arch is mostly extrapericardial.

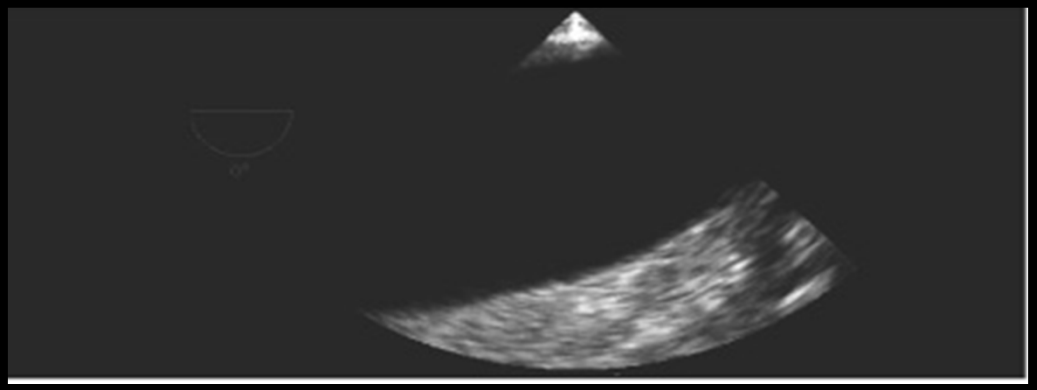
Normal diameter = 2.5 ± 0.2 cm

Aortic Arch



Using suprasternal views, variable amounts of the aortic arch, ascending aorta and descending aorta are imaged.

Aortic Arch



TEE is easily observed the aortic arch, but is blinded over some portion of the arch by the tracheal air column.

Isthmus and Descending Thoracic Aorta

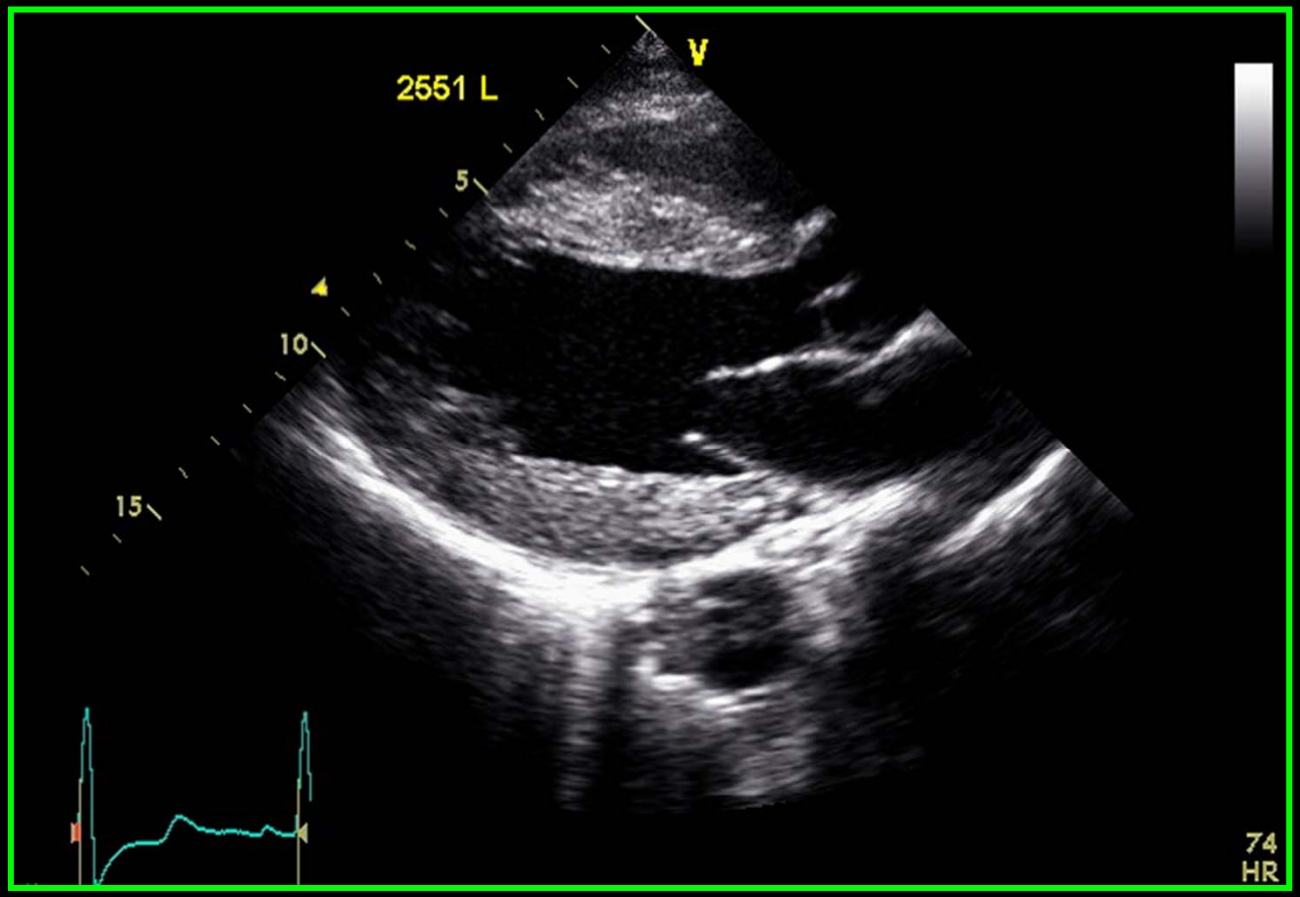
- The isthmus is the short portion of the aorta after the left subclavian artery to the present or former ductus arteriosus.

Isthmus and Descending Thoracic Aorta

- The descending aorta is the vertically oriented portion of the aorta continuing from the isthmus to the level of the diaphragm. The esophagus runs alongside (within 0.5 cm) the descending aorta.
- Normal diameter <3.0 cm
- At the 11th rib level <2.3 cm

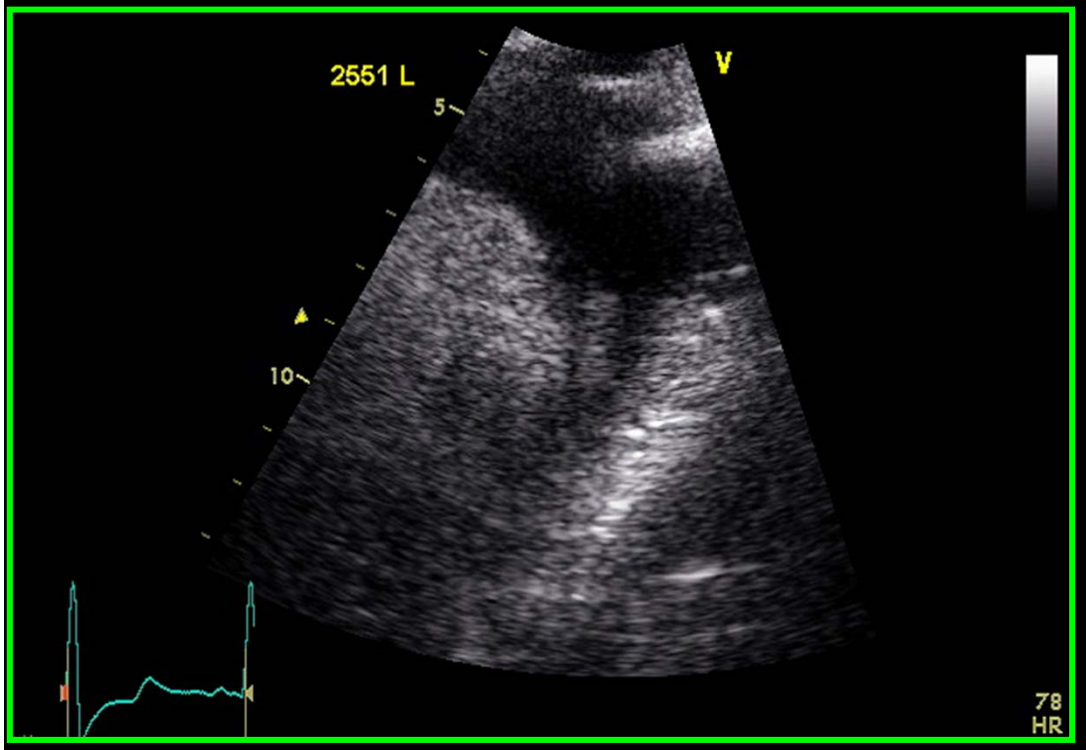
TTE

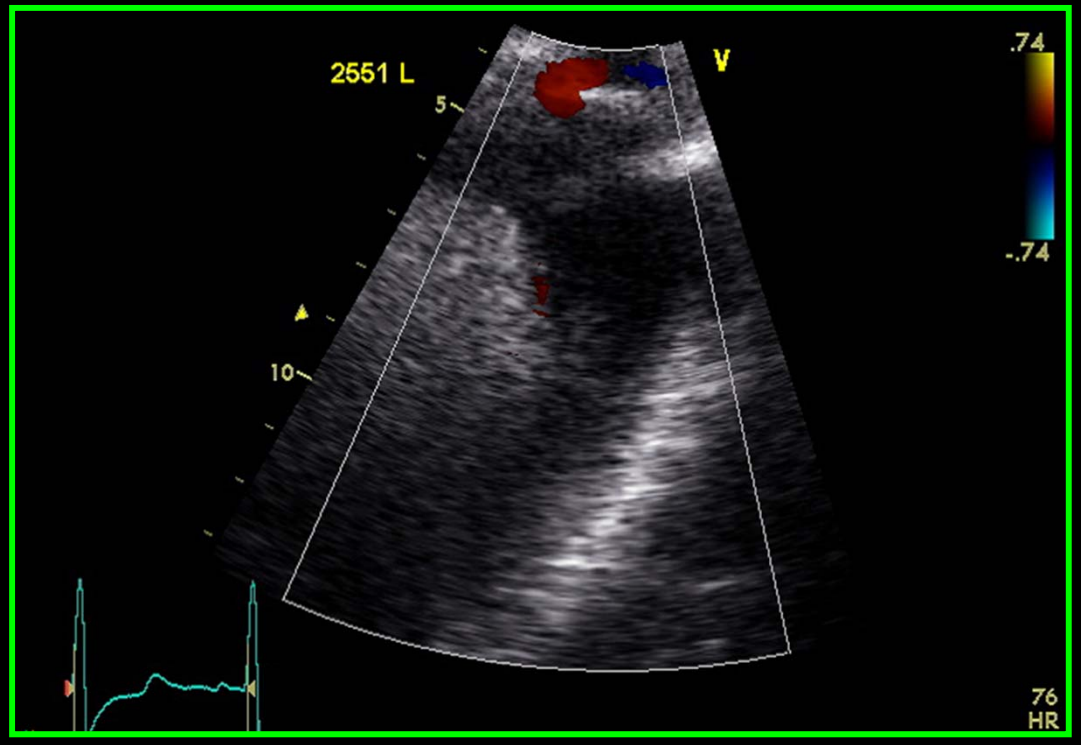
Aortic Dissection



TTE

Aortic Dissection





TEE

Aortic Dissection

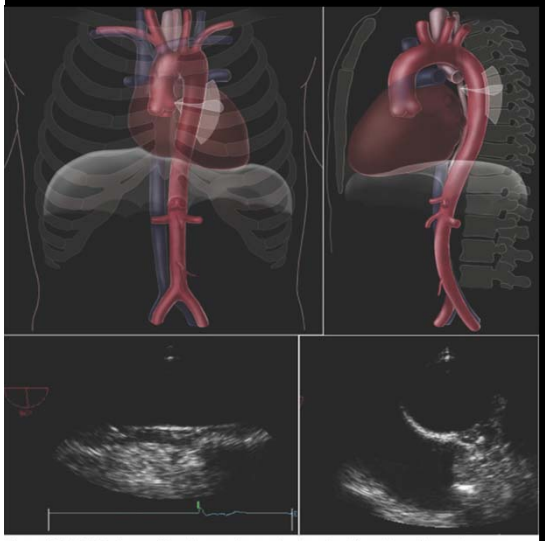
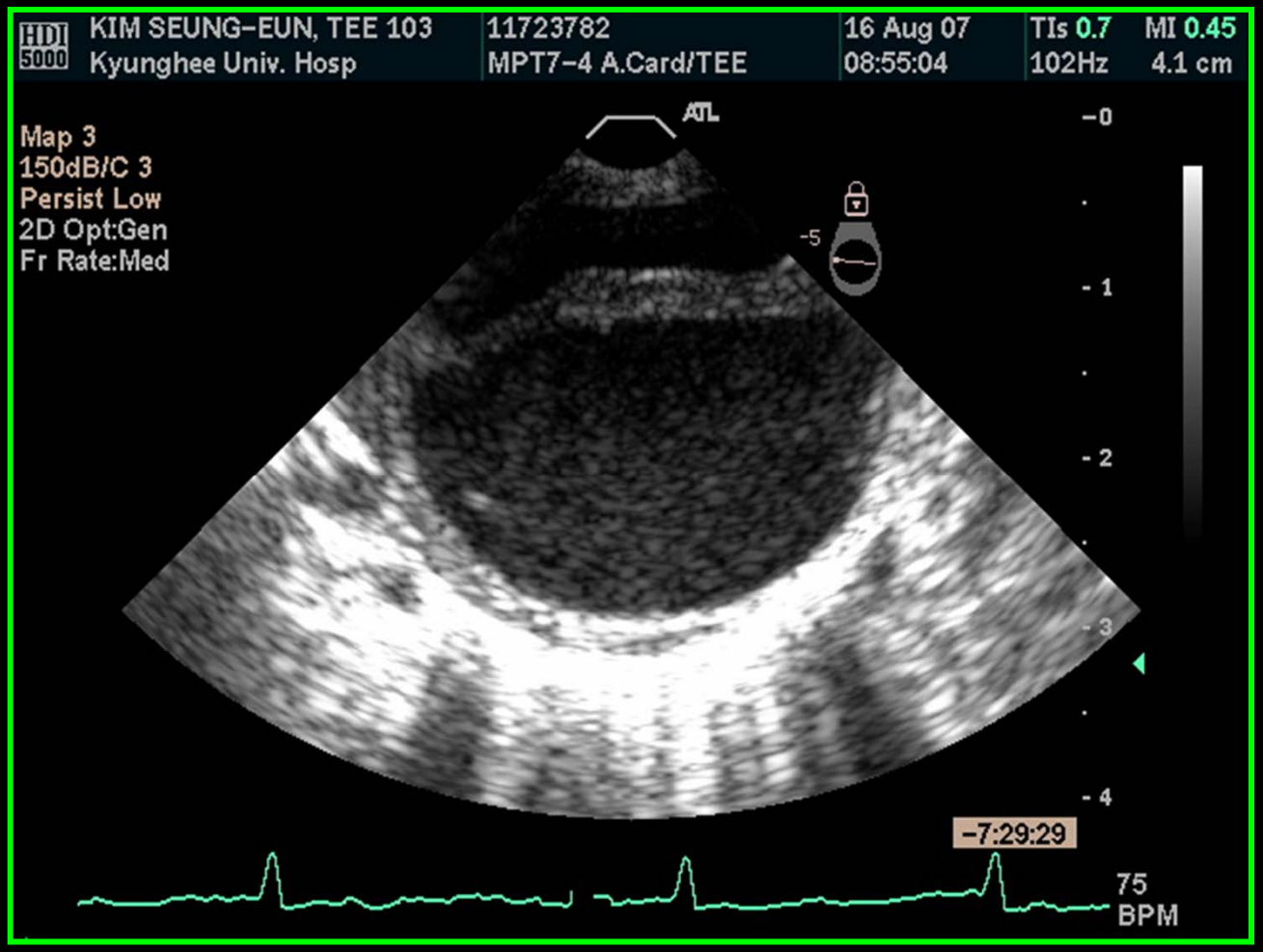
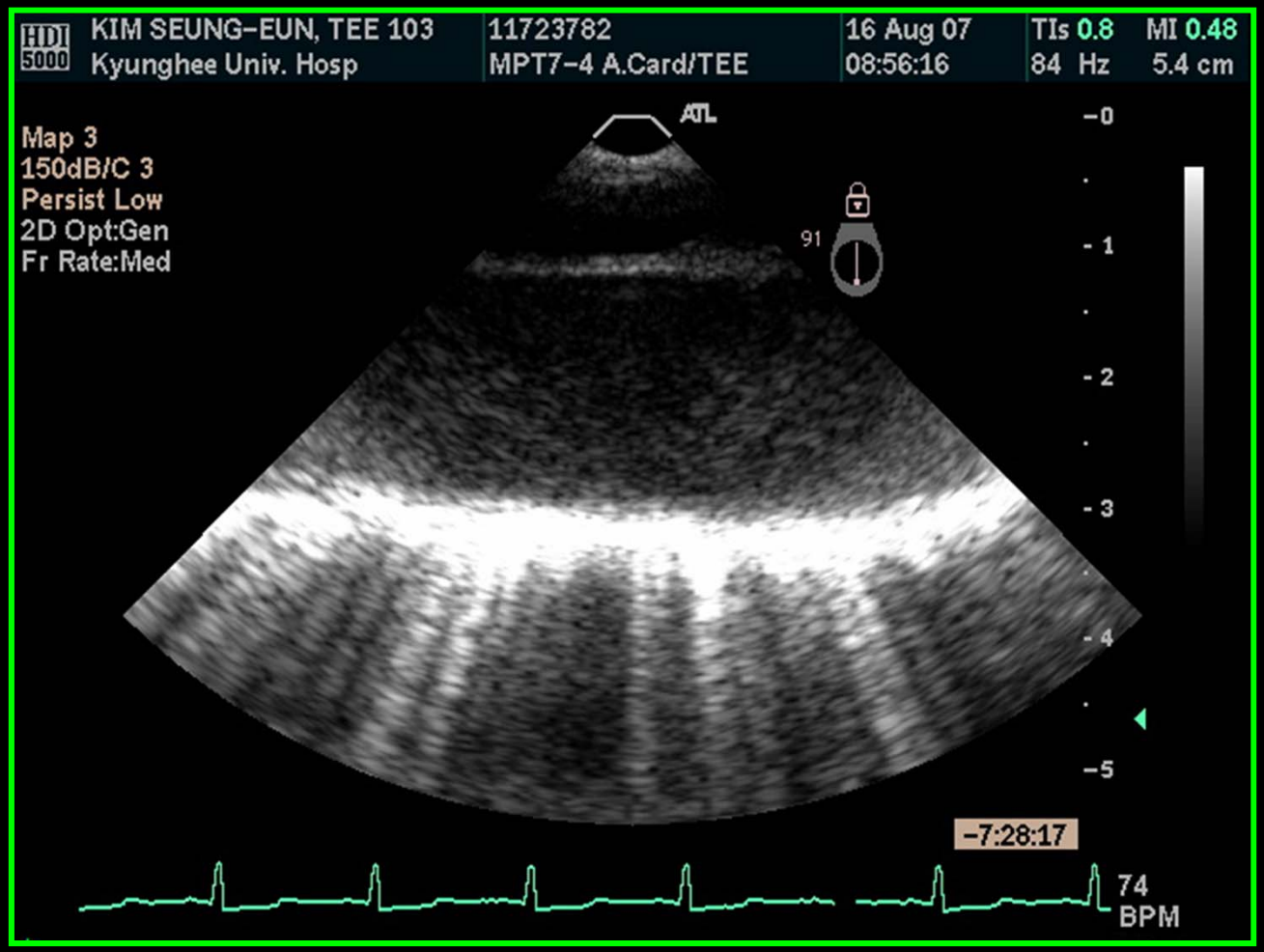


Figure 3-14. TEE views of the descending aorta. Acquired from the mid esophagus, transverse (short-axis, 0 degrees) and longitudinal (long-axis, 90 degrees) views are obtained at multiple levels. Short- and long-axis views are orthogonal to each other (different by 90 degrees). Imaging the entirety of an enlarged aorta may be difficult if its diameter is greater than the sector of imaging can encompass. This is most problematic for near-field imaging, where the sector is narrowest.



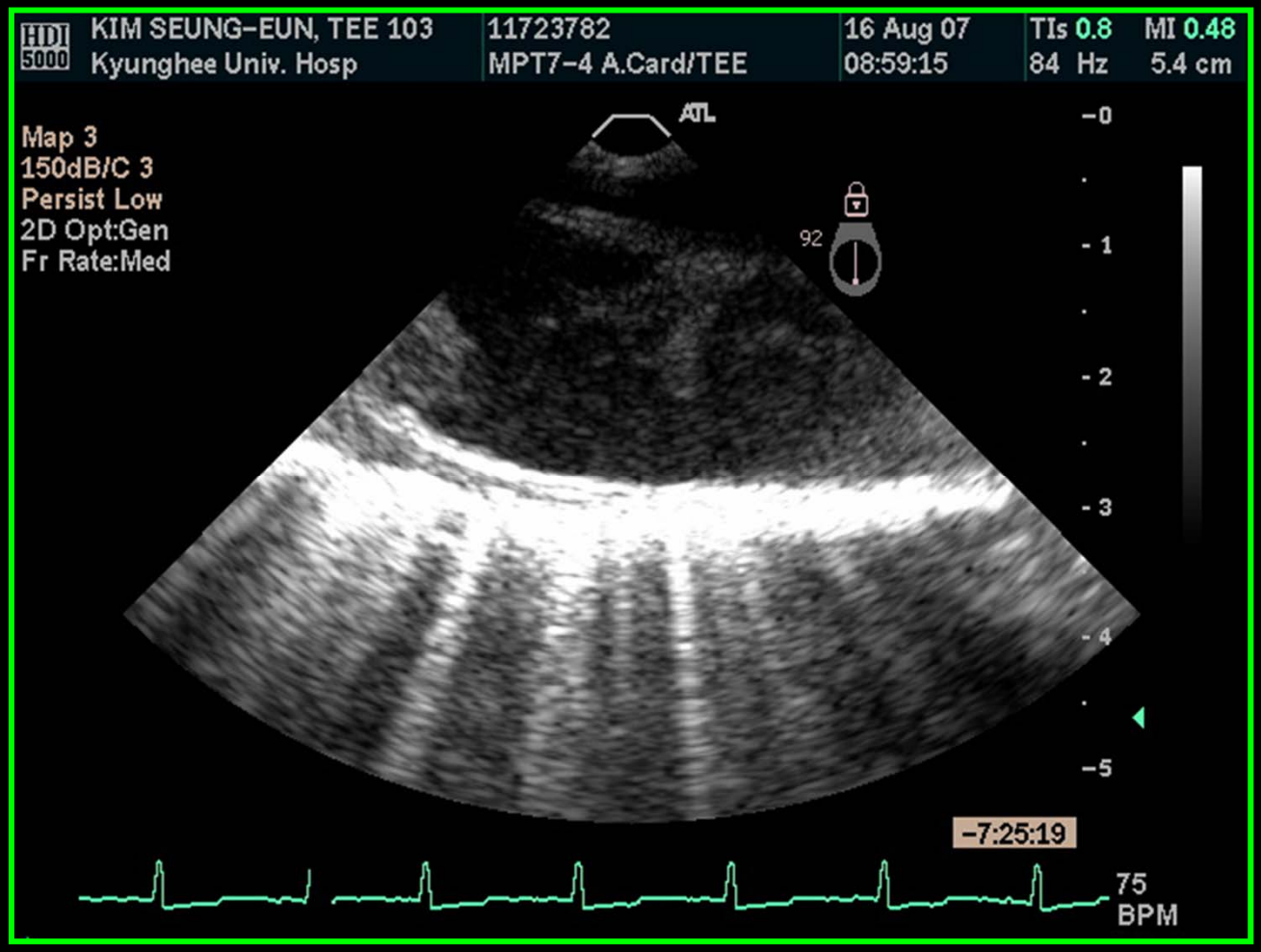
TEE

Aortic Dissection



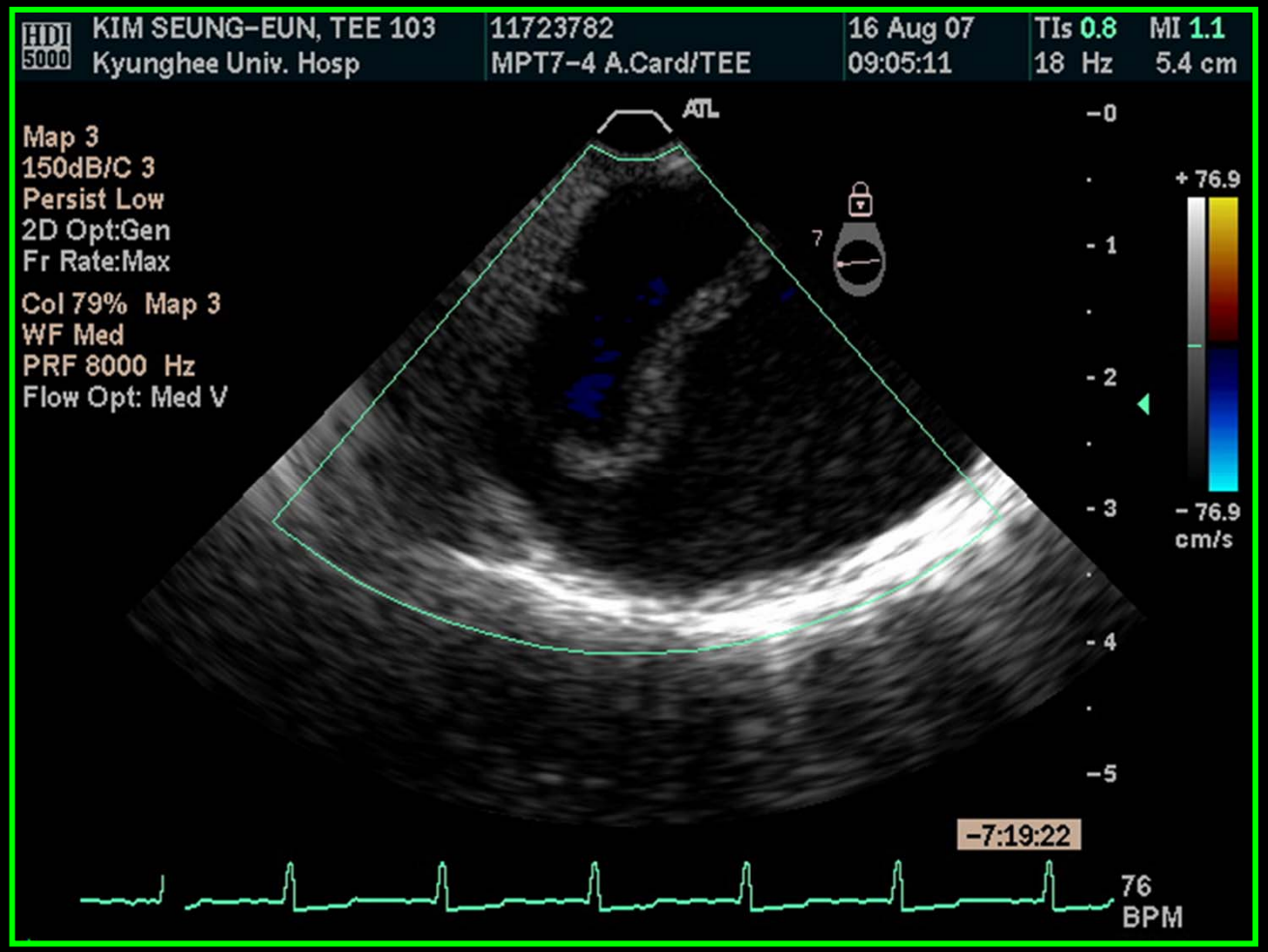
TEE

Aortic Dissection



TEE

Aortic Dissection



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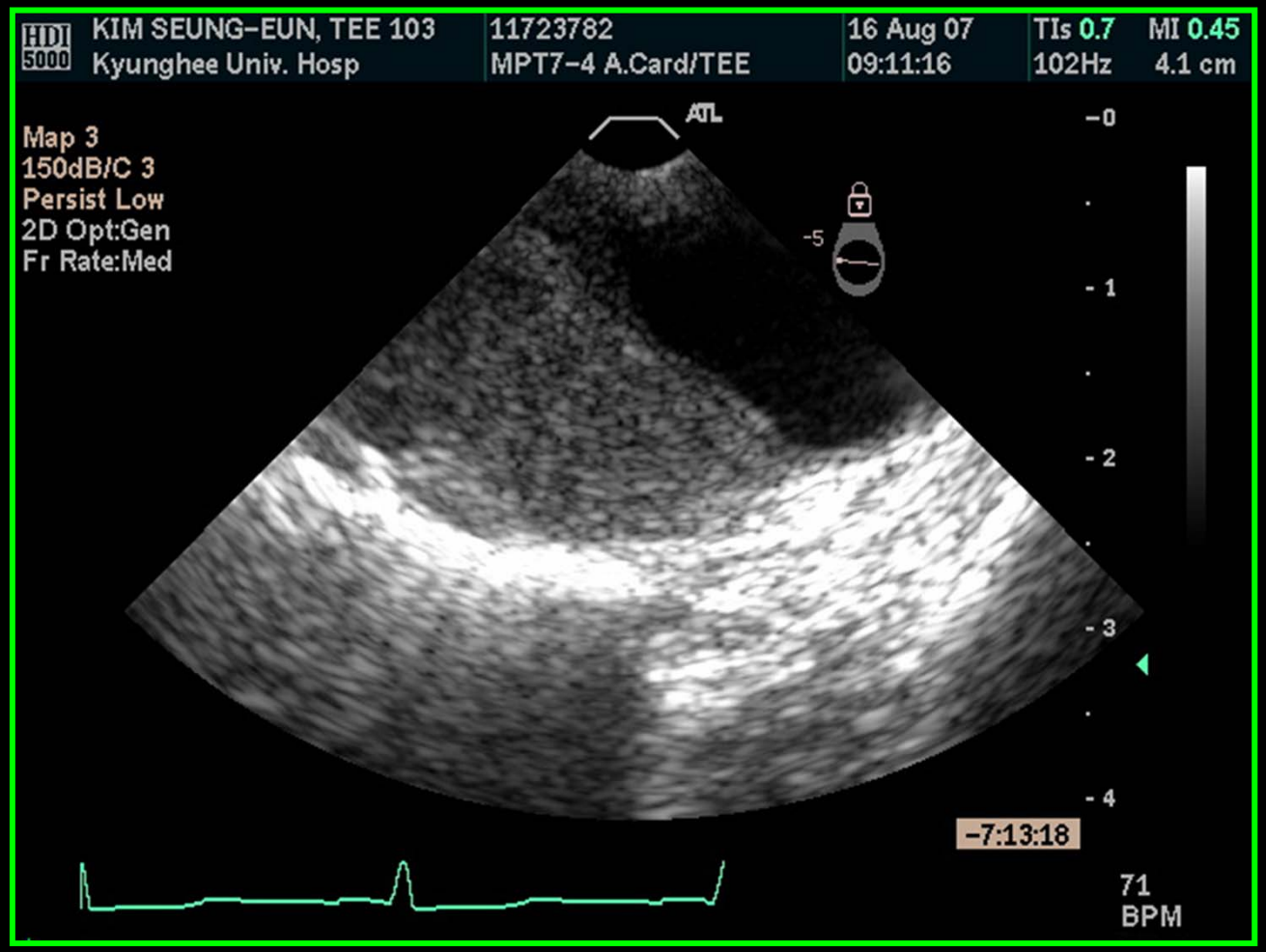
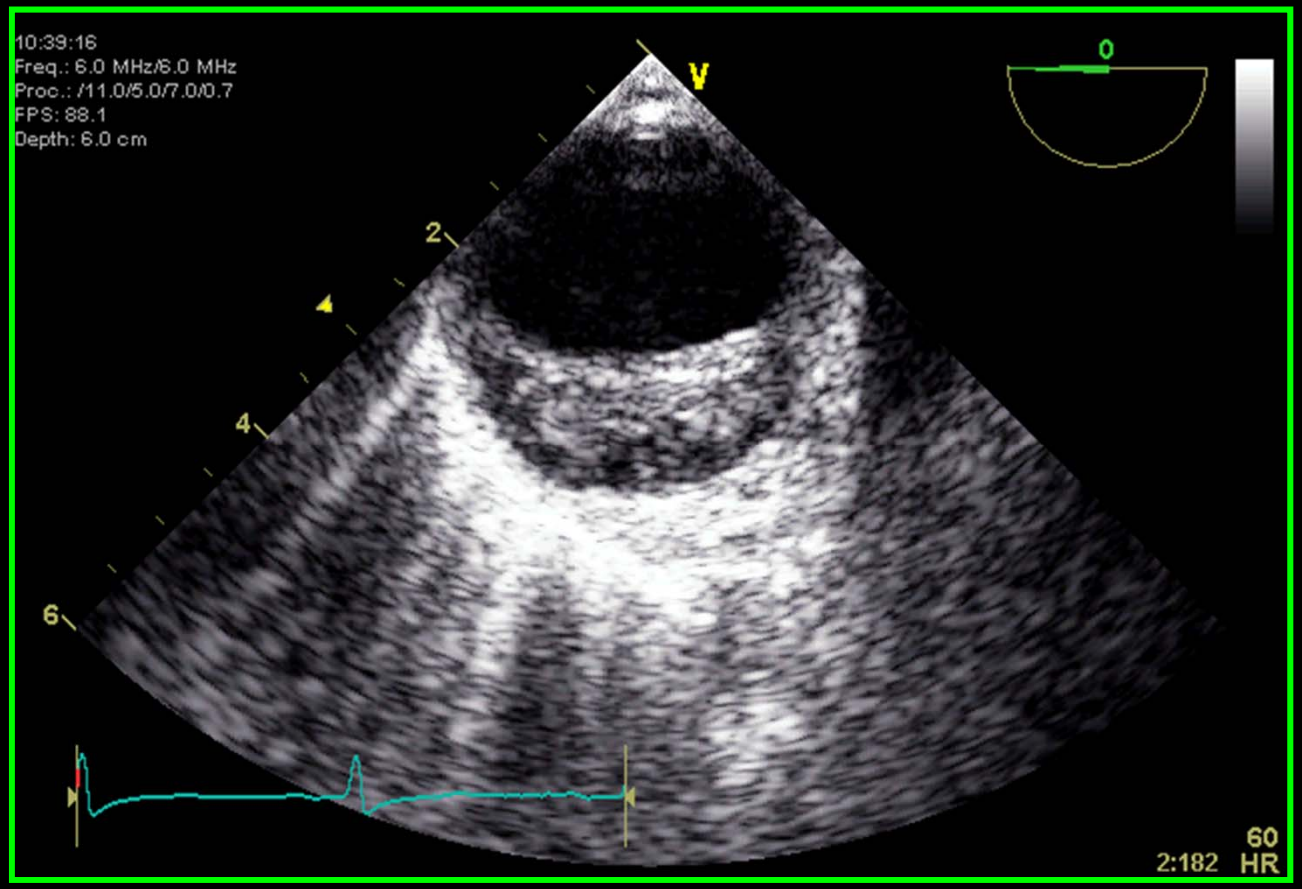
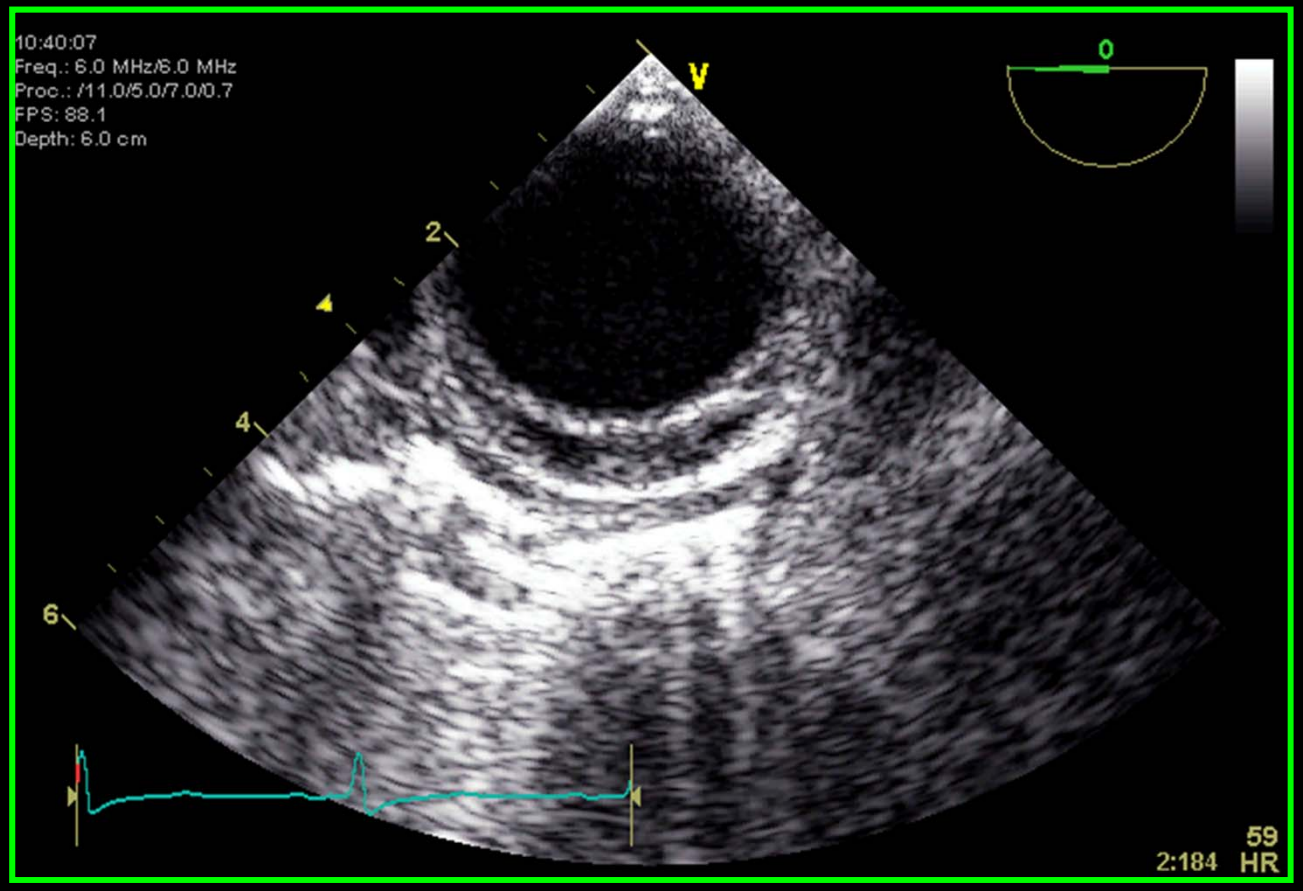
Aortic Dissection



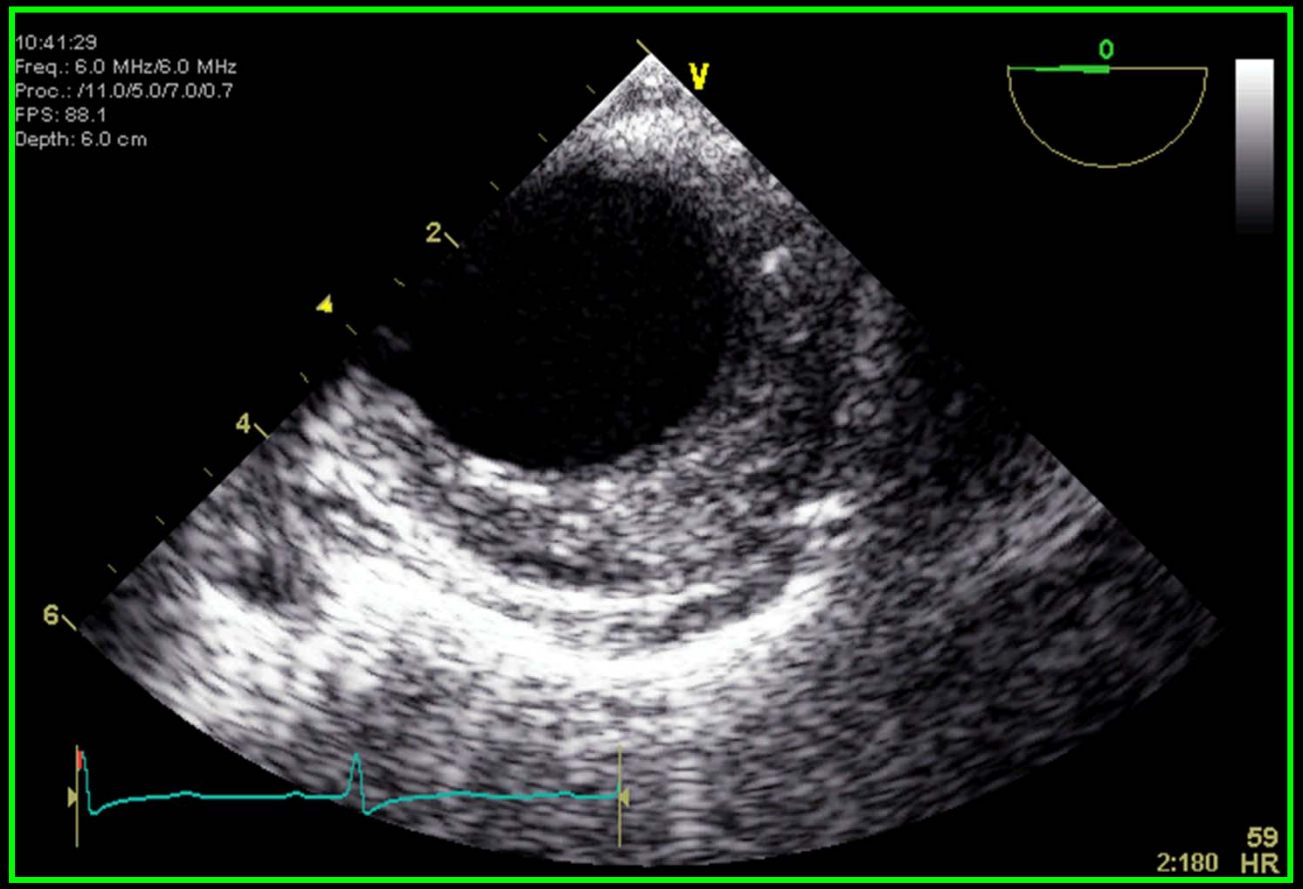
35 cm Intramural hematoma



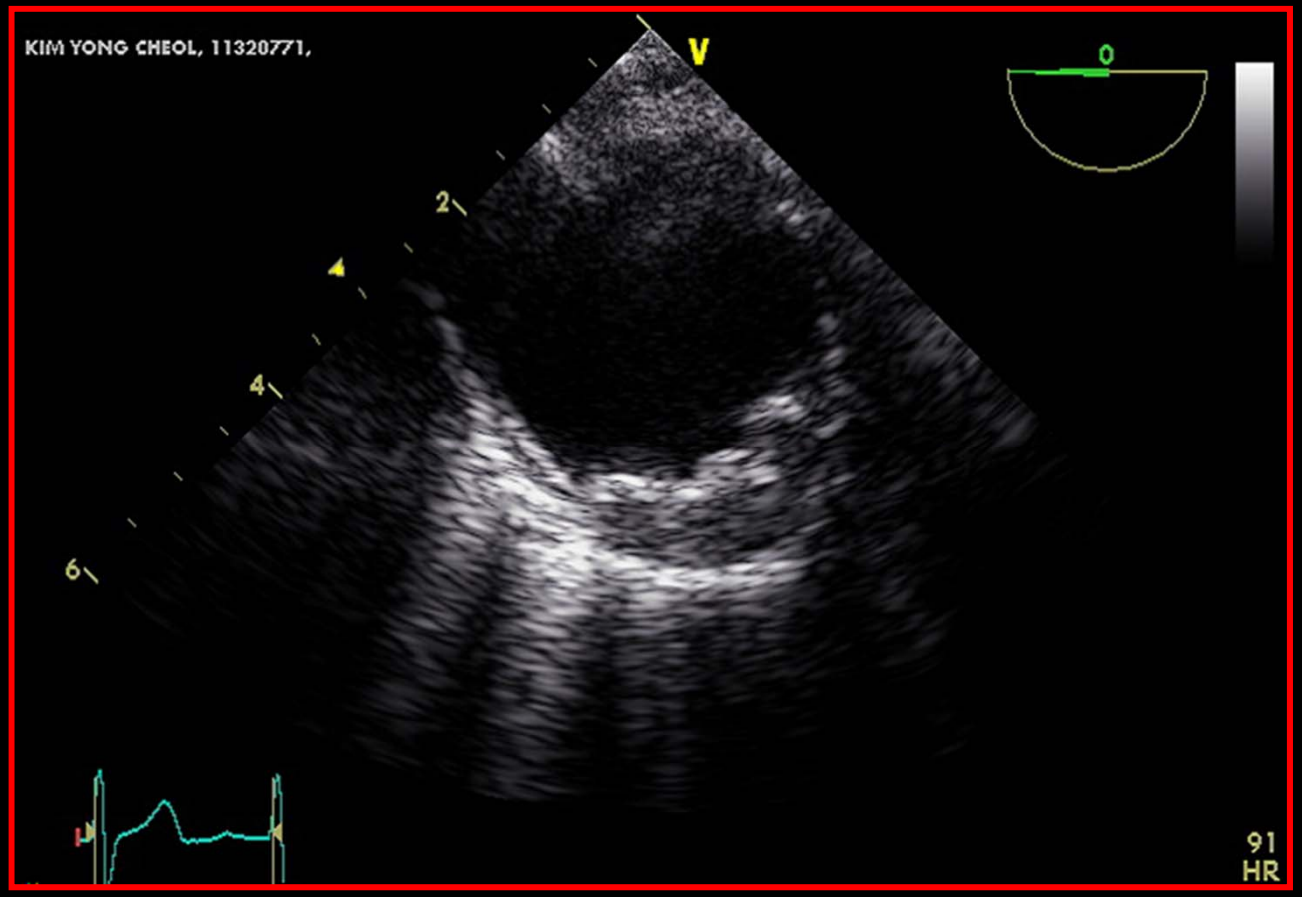
31 cm Intramural hematoma



27 cm Intramural hematoma

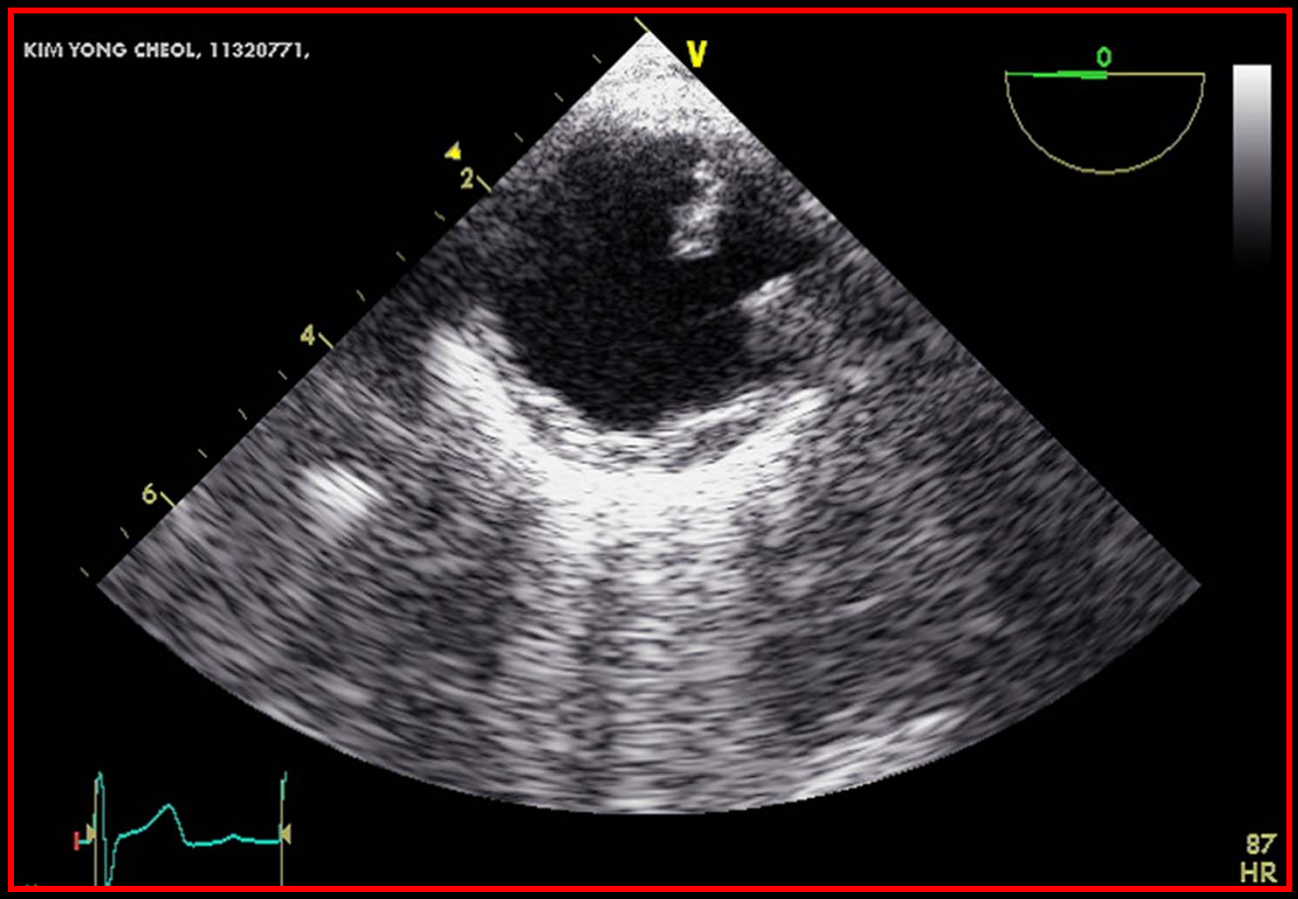


Aortic Atherosclerosis



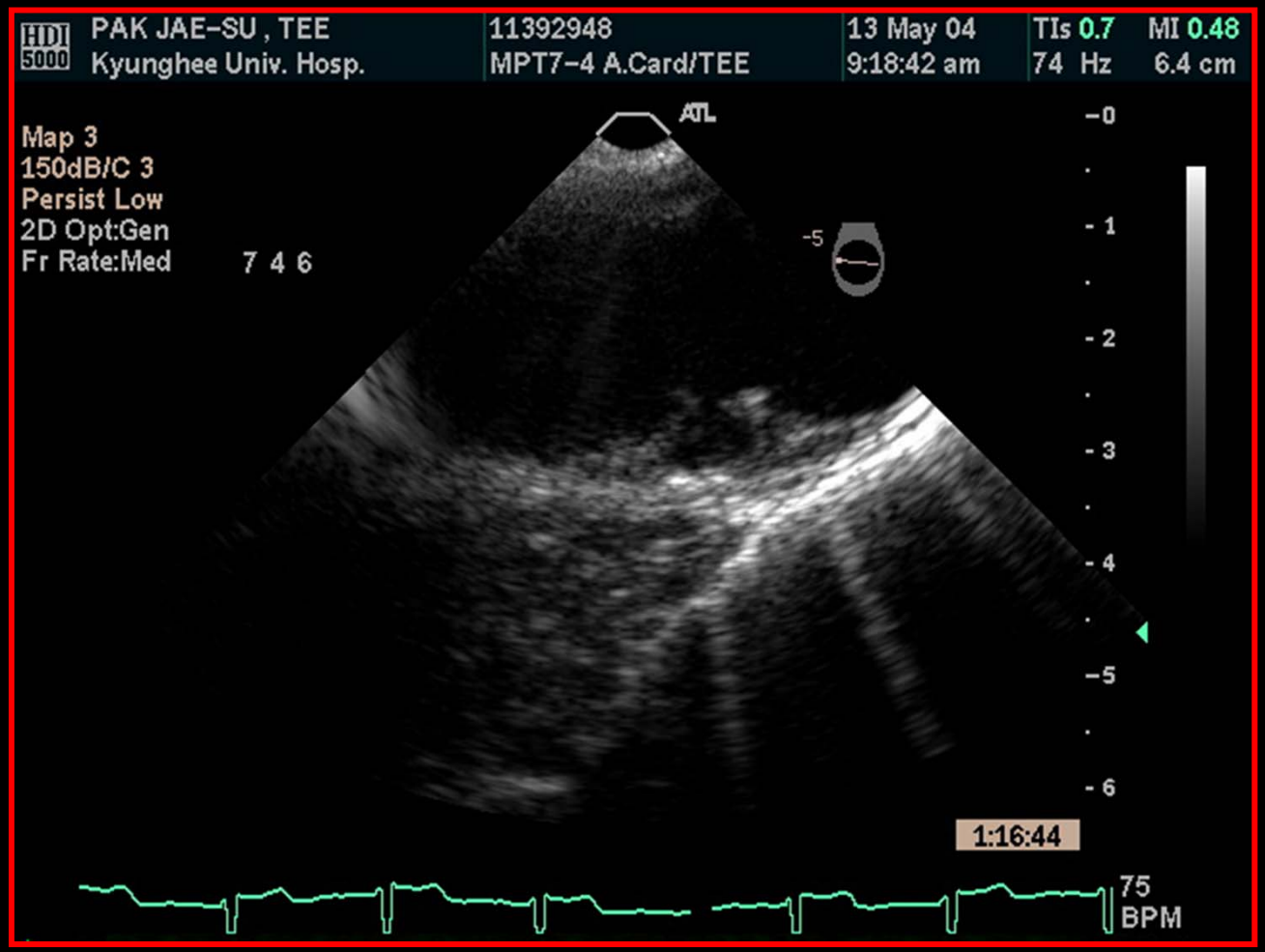
- Normal intima is smooth and less than 2 mm.
- Atheroma is identified by thickening of the intima.

Aortic Atherosclerosis



Accompanied with mobile atheroma, the occurrence of the risk of strokes increases.

Aortic Atherosclerosis



Classification of aortic atheroma

Royse et al. (Ann of Thoracic Cardiovas Surgery)

Normal	Smooth intima, <2 mm thick
Mild	Smooth intima, 2~4 mm thick
Moderate	Smooth intima, >4 mm thick
Severe	Complex shape or mobile, >4 mm thick

Katz et al (JACC 1992)

Grade 1	Normal or mild intimal thickening
Grade 2	Severe intimal thickening, no protruding atheroma
Grade 3	Atheroma protruding <5 mm into lumen
Grade 4	Atheroma protruding >5 mm into lumen
Grade 5	Atheroma of any size with a mobile component

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PRACTICE GUIDELINE: EXECUTIVE SUMMARY

2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM Guidelines for the Diagnosis and Management of Patients With Thoracic Aortic Disease: Executive Summary

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine

Endorsed by the North American Society for Cardiovascular Imaging

WRITING COMMITTEE MEMBERS

Loren F. Hiratzka, MD, Chair*; George L. Bakris, MD†; Joshua A. Beckman, MD, MS‡; Robert M. Bersin, MPH, MD§; Vincent F. Carr, DO‖; Donald E. Casey Jr, MD, MPH, MBA¶; Kim A. Eagle, MD*#; Luke K. Hermann, MD**; Eric M. Isselbacher, MD*; Ella A. Kazerooni, MD, MS††; Nicholas T. Kouchoukos, MD‡‡; Bruce W. Lytle, MD§§; Dianna M. Milewicz, MD, PhD; David L. Reich, MD‖‖; Souvik Sen, MD, MS¶¶; Julie A. Shinn, RN, MA, CCRN†; Lars G. Svensson, MD, PhD##; David M. Williams, MD#***

Normal Adult Thoracic Aortic Diameters

Thoracic Aorta	Range of Reported Mean (cm)	Reported SD (cm)	Assessment Method
Root (female)	3.50 to 3.72	0.38	CT
Root (male)	3.63 to 3.91	0.38	CT
Ascending (female, male)	2.86	NA	CXR
Mid-descending (female)	2.45 to 2.64	0.31	CT
Mid-descending (male)	2.39 to 2.98	0.31	CT
Diaphragmatic (female)	2.40 to 2.44	0.32	CT
Diaphragmatic (male)	2.43 to 2.69	0.27 to 0.40	CT, arteriography

The diameter of aorta should be measured

ACC/AHA – Aortic Imaging Guidelines

1. Measure aorta at reproducible landmarks, perpendicular to blood flow, reported in clear, consistent format
2. CT/MR – external diameter perpendicular to flow
3. Echo – internal diameter perpendicular to flow
4. Minimize episodic and cumulative radiation exposure

ACC/AHA – Aortic Imaging Guidelines

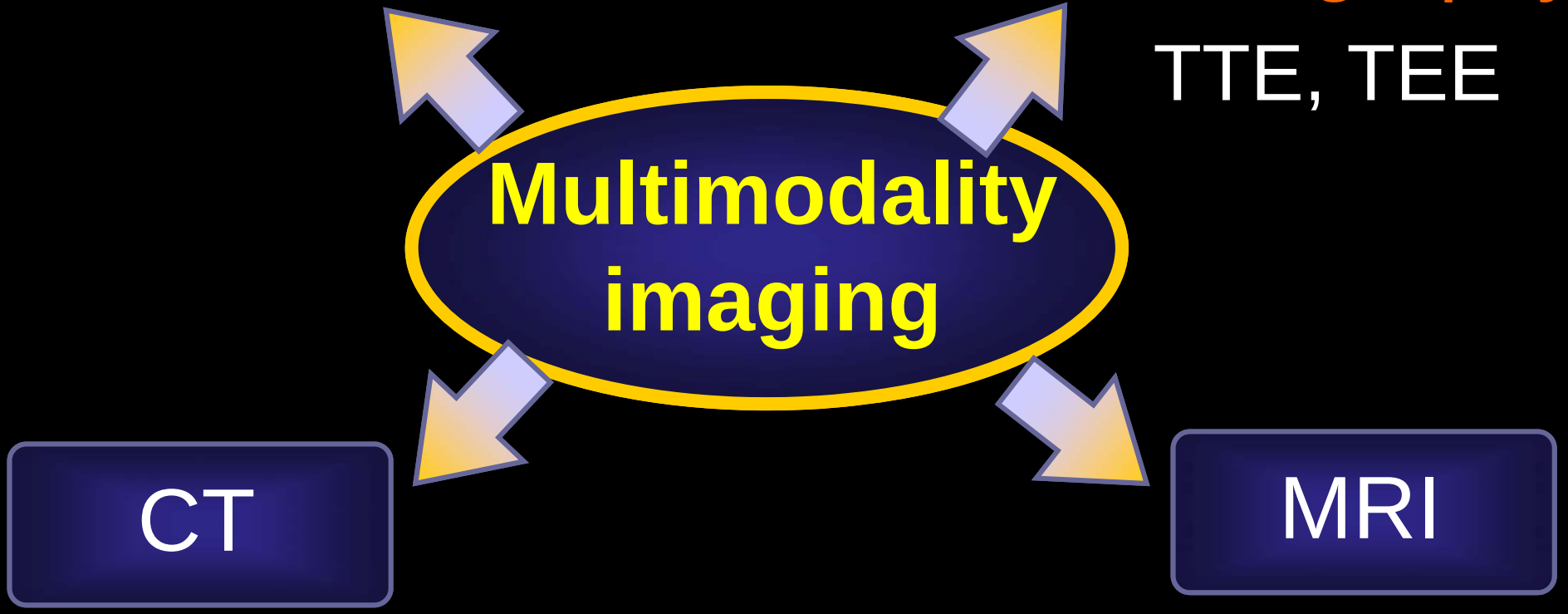
5. Report abnormalities of aortic morphology separately even when aortic diameters are within normal limits
6. Immediately communicate findings of aortic dissection, aneurysm, traumatic injury and/or aortic rupture to referring physician

Patients with Aortopathy

Angiography

Echocardiography

TTE, TEE



There are many methods and ways in which the aorta can be observed.

Diagnostic Techniques

- The 1st choice for recent aorta imaging
  - **Contrast enhanced CT**
  - **TEE**
    - Aortic valve disease is suspected.
    - Patient is unstable.

Diagnostic Techniques

- **Echocardiography**
  - Advantages
    - Readily available
    - Noninvasive procedure
    - Quick to perform at the bedside
  - Transthoracic echocardiography (TTE)
    - Sensitivity: 59 – 85%
    - Specificity: 63 – 96%
    - Limited by image quality

Diagnostic Techniques

- **Transesophageal echocardiography (TEE)**
  - Advantages
    - High imaging quality with high frequency ultrasound
    - Not require contrast materials
    - Aortic regurgitation
    - Pericardial effusion
    - High sensitivity and specificity
      - Sensitivity: 98 – 99%
      - Specificity: 94 – 97%
  - Disadvantages
    - Not visualize distal ascending aorta and proximal arch

CONCLUSION

There are many methods and ways in which the aorta can be observed.

There are both advantages and disadvantages of each method.

By maximizing these advantages, it can result in effective diagnosis and treatment.


Thank you