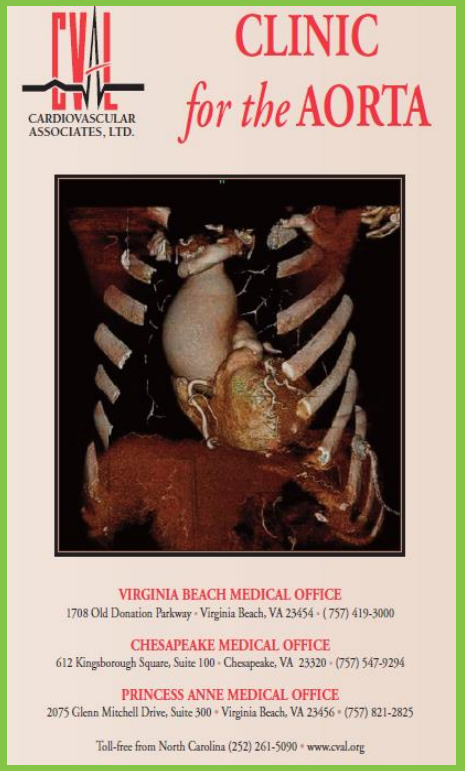
2018 MID-ATLANTIC
CONFERENCE

8th ANNUAL CURRENT CONCEPTS IN
VASCULAR THERAPIES

2018

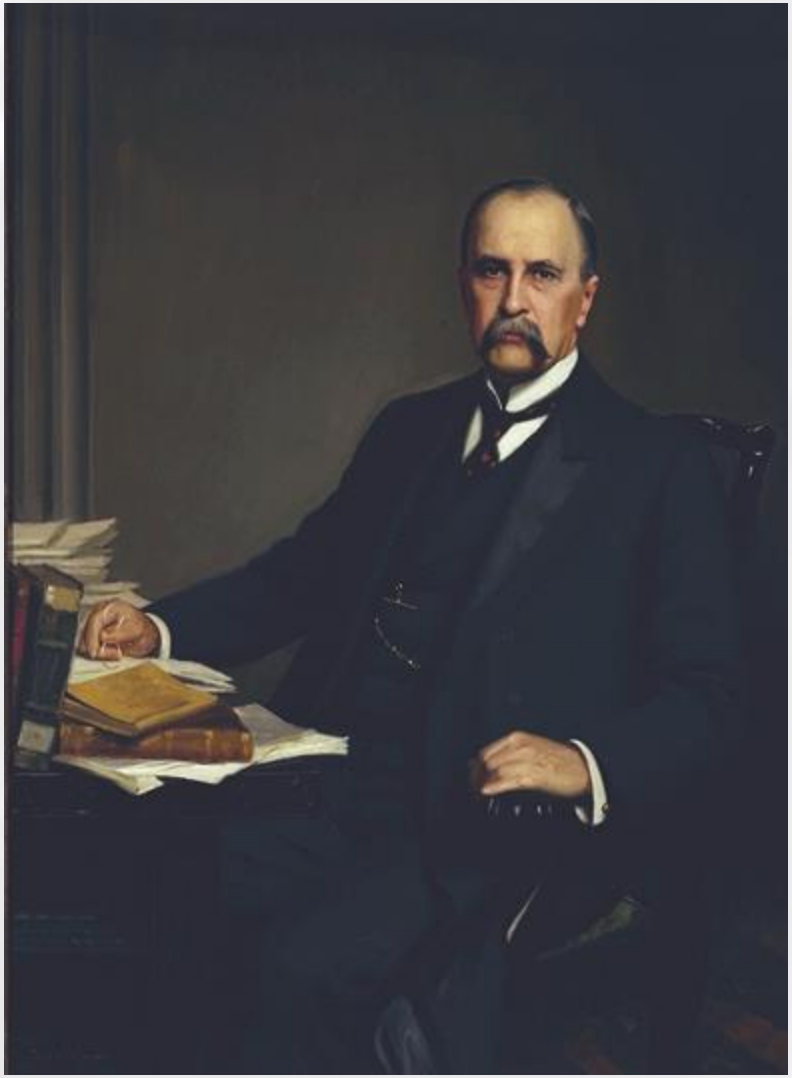
Aortic Imaging and Follow-up

Mohit Bhasin MD

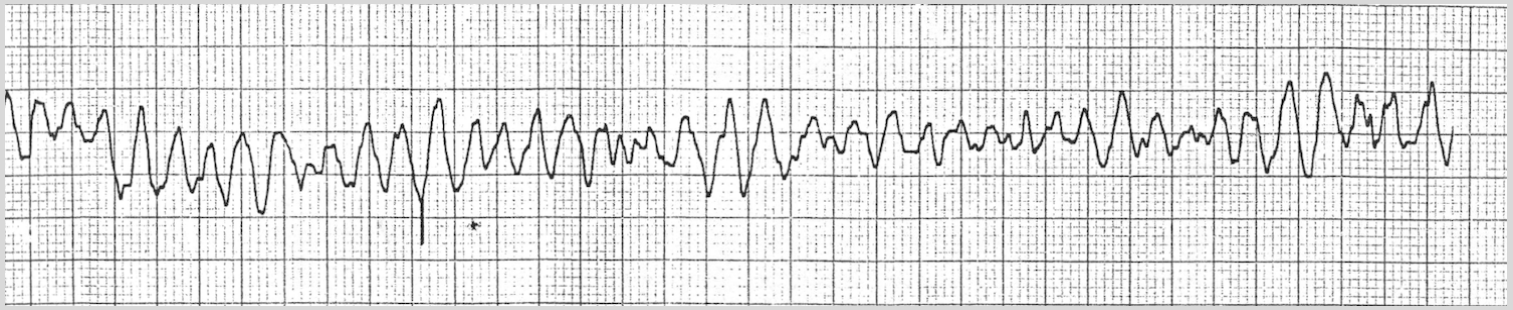


IHS

"There is no condition more conducive to clinical humility than aneurysm of the aorta.”

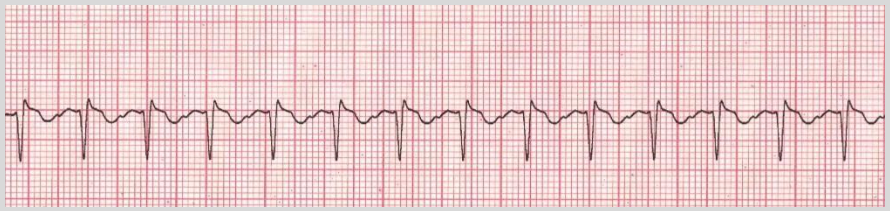


William Osler



55 yo F suddenly develops **ventricular fibrillation**

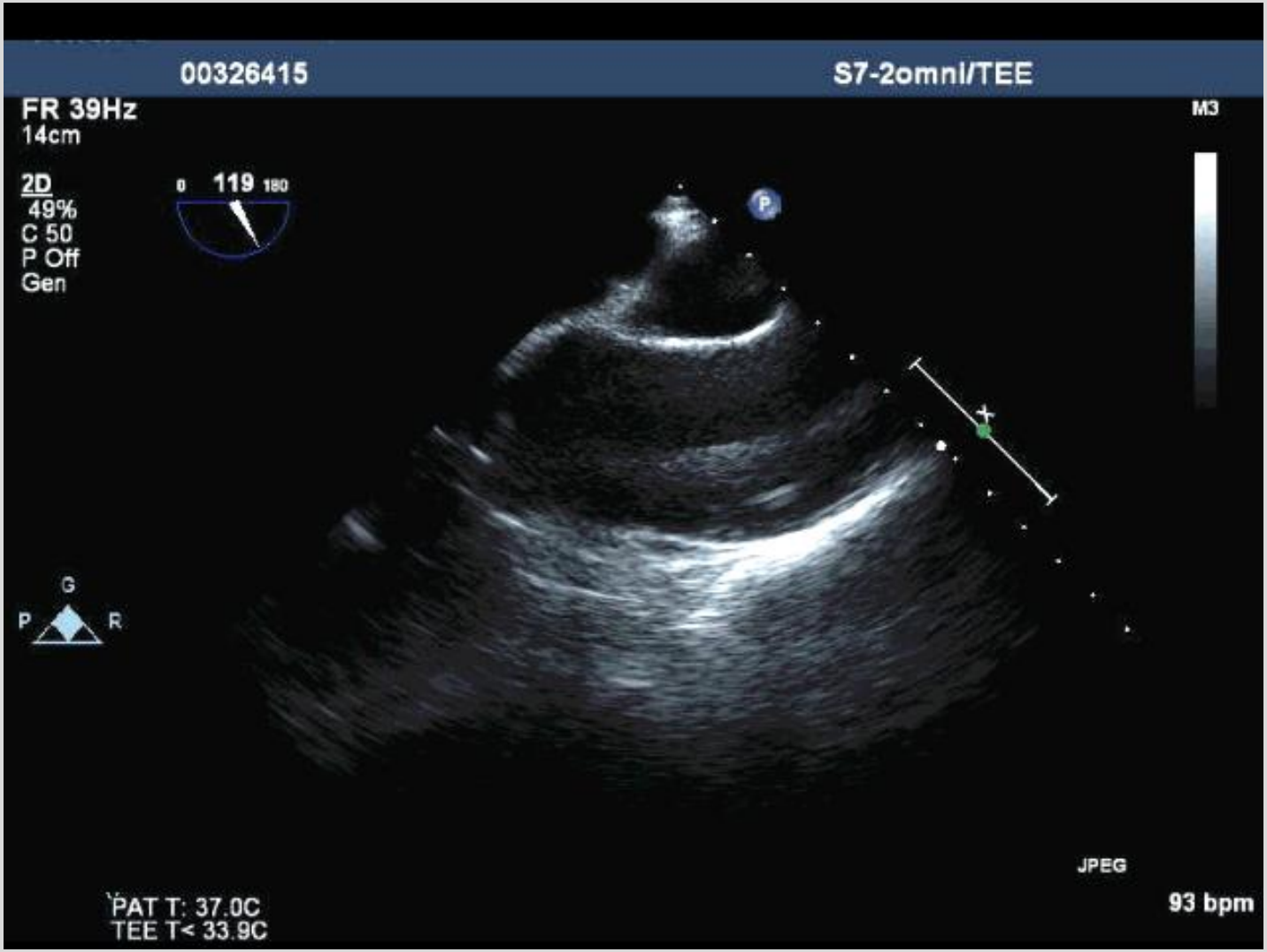
– Defibrillated in the field with an AED

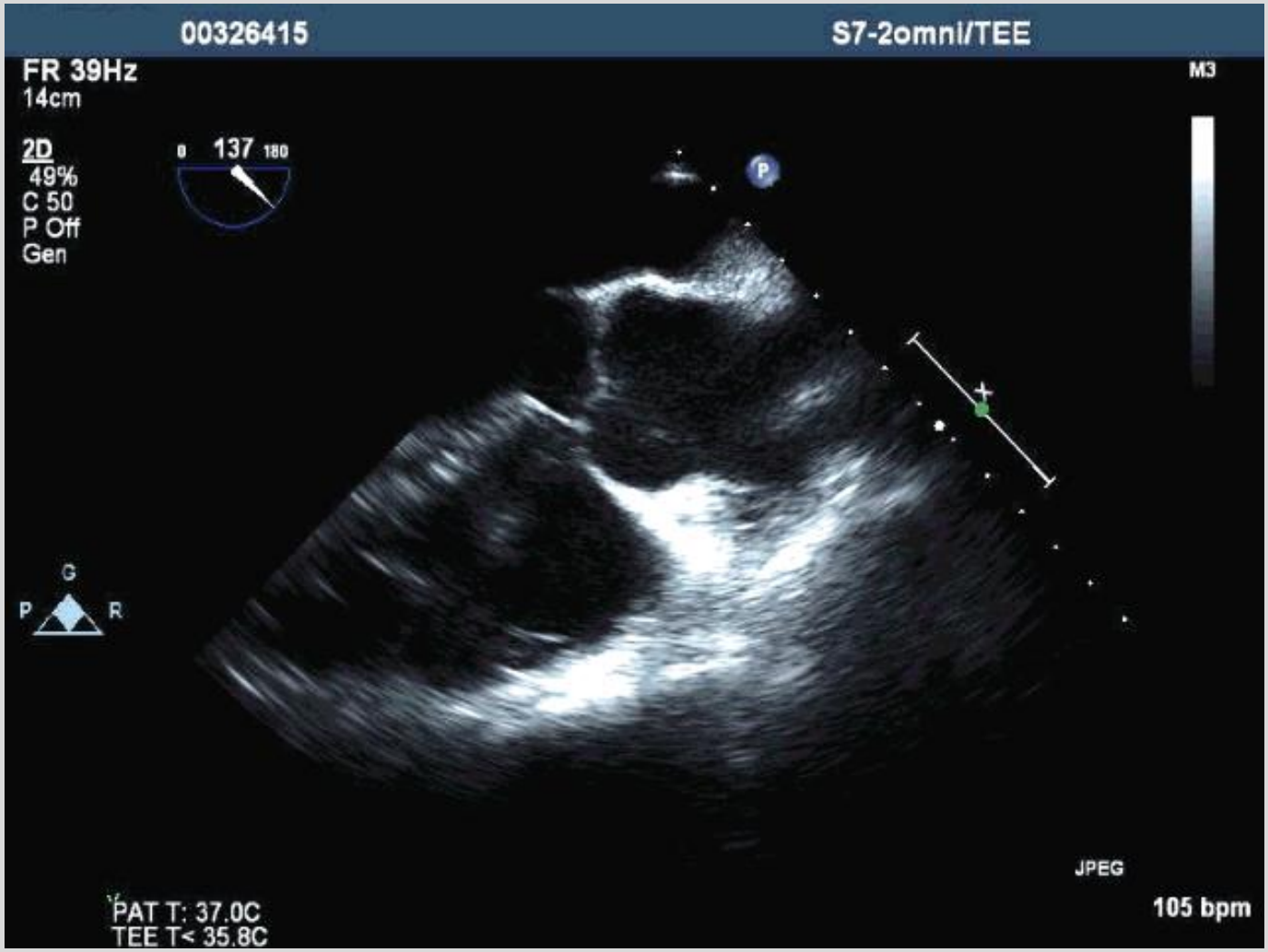


– Brought to ER in Sinus Tachycardia

- Diaphoretic, SBP= 94 mmHG
- No ST deviations by EKG
- **“Widened Mediastinum” suggested by CXR**

STAT transesophageal echo (TEE):


00326415
S7-2omni/TEE
FR 39Hz
14cm
2D
49%
C 50
P Off
Gen
0
119
180
M3
G
P
R
JPEG
PAT T: 37.0C
TEE T< 33.9C
93 bpm


00326415
S7-2omni/TEE
FR 39Hz
14cm
2D
49%
C 50
P Off
Gen
0 137 180
M3
G
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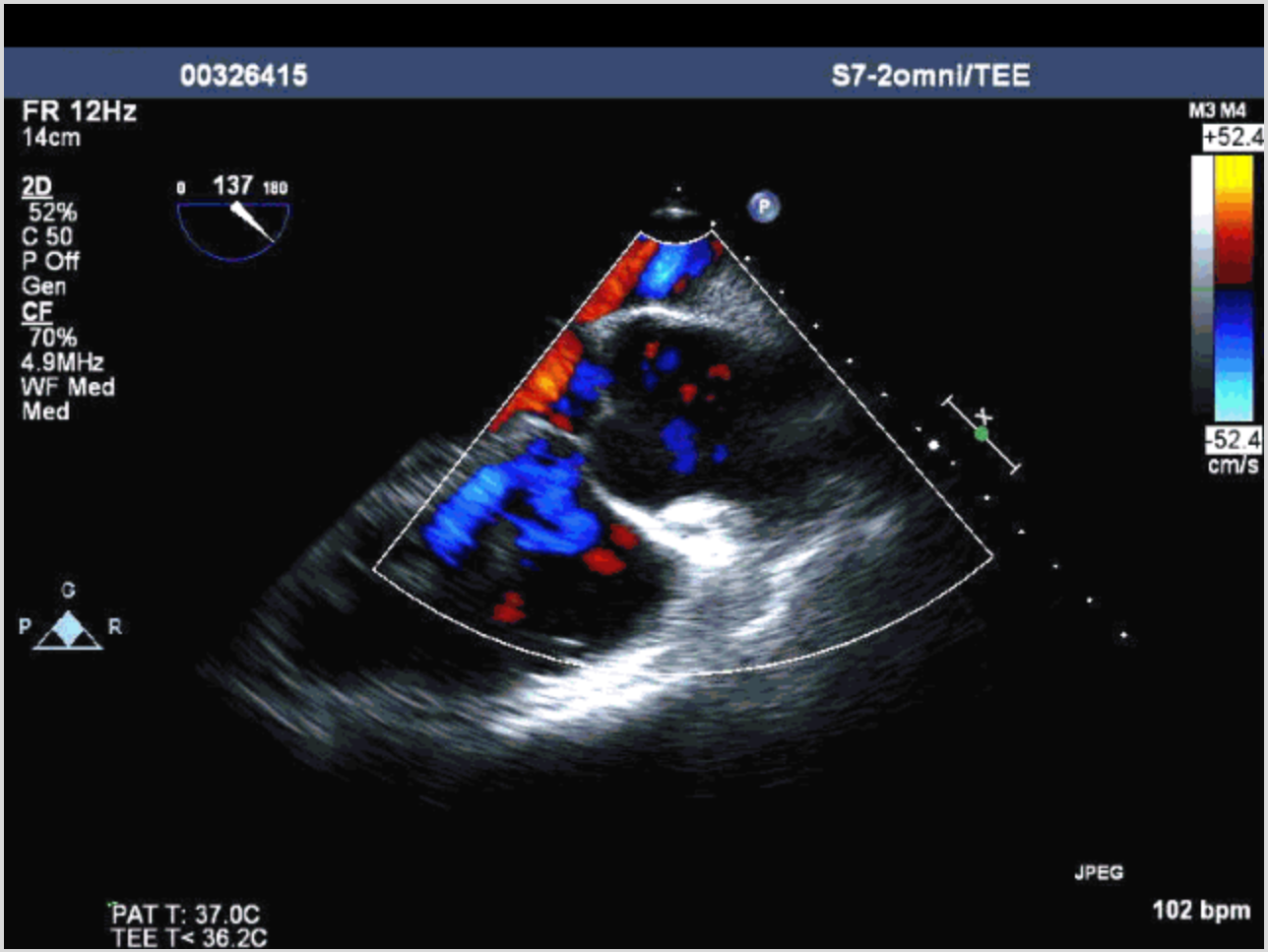
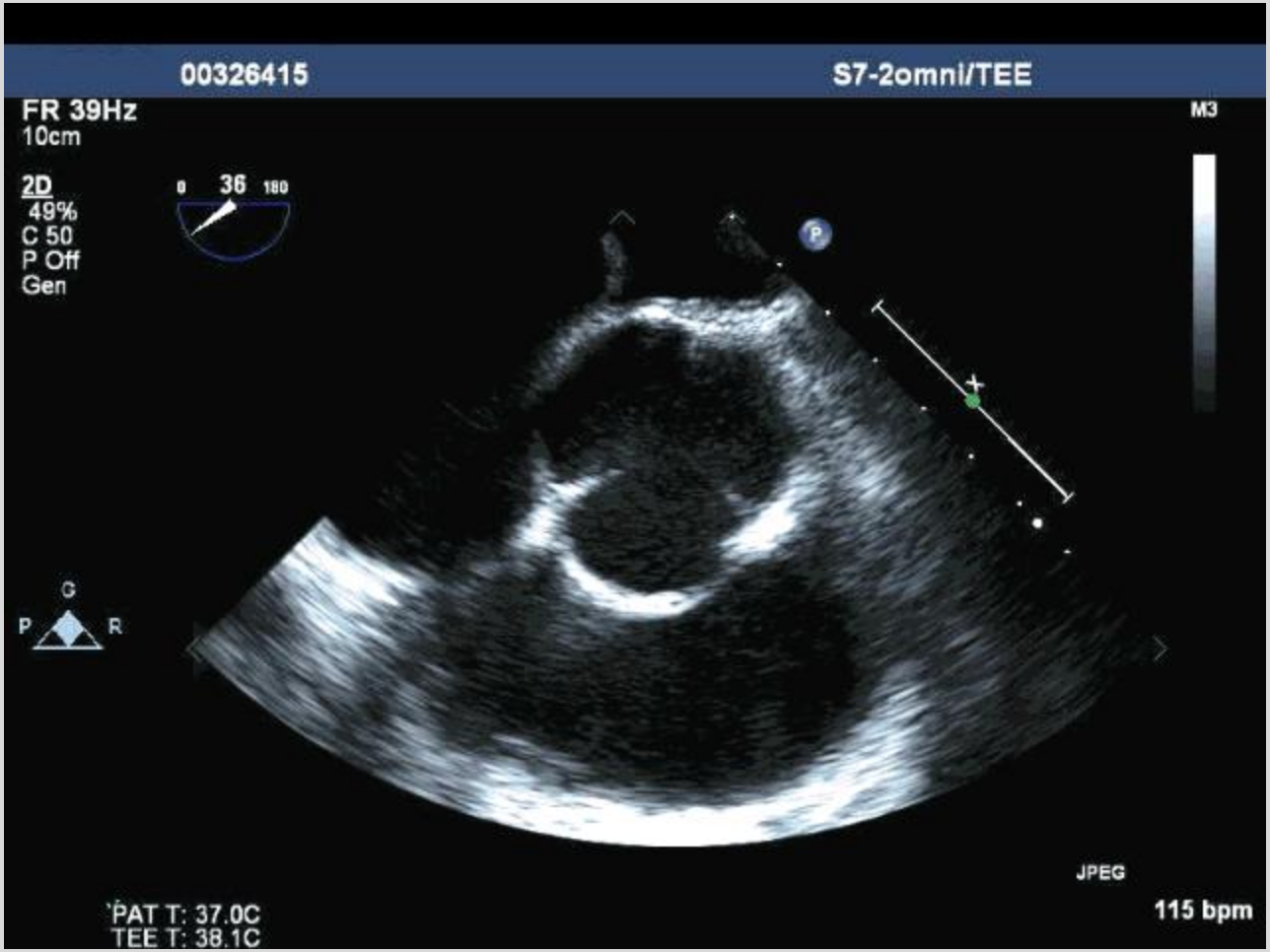
R
JPEG
105 bpm
PAT T: 37.0C
TEE T< 35.8C


00326415
S7-2omni/TEE
FR 12Hz
14cm
2D
52%
C 50
P Off
Gen
CF
70%
4.9MHz
WF Med
Med
0 137 180
M3 M4
+52.4
-52.4
cm/s
G
P
R
JPEG
PAT T: 37.0C
TEE T< 36.2C
102 bpm


00326415
S7-2omni/TEE
FR 39Hz
10cm
M3
2D
49%
C 50
P Off
Gen
0
36
180
P
C
P
R
JPEG
PAT T: 37.0C
TEE T: 38.1C
115 bpm


00326415
S7-2omni/TEE
FR 39Hz
11cm
2D
46%
C 50
P Off
Gen
0 118 180
M3
P
C
P
R
JPEG
100 bpm
PAT T: 37.0C
TEE T: 38.6C

What would you do next ?

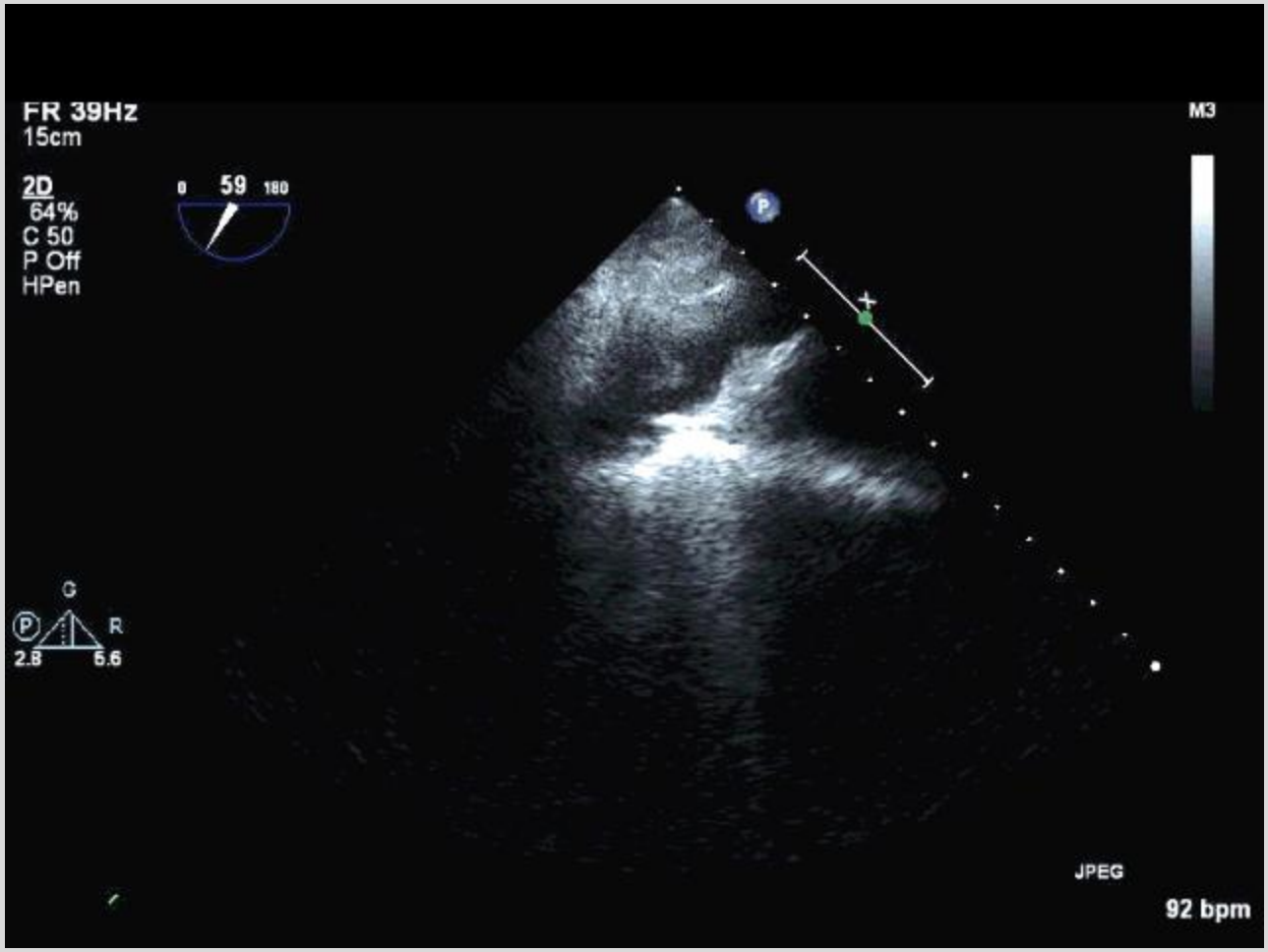
(1) Send patient to the O.R. for acute aortic dissection

(2) Bolus with heparin and consider lytics

(3) Admit for observation

(4) None of the above


00326415
S7-2omni/TEE
FR 39Hz
11cm
2D
46%
C 50
P Off
Gen
0
118
180
M3
P
C
P
R
JPEG
100 bpm
PAT T: 37.0C
TEE T: 38.6C


FR 39Hz
15cm
2D
64%
C 50
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C
P
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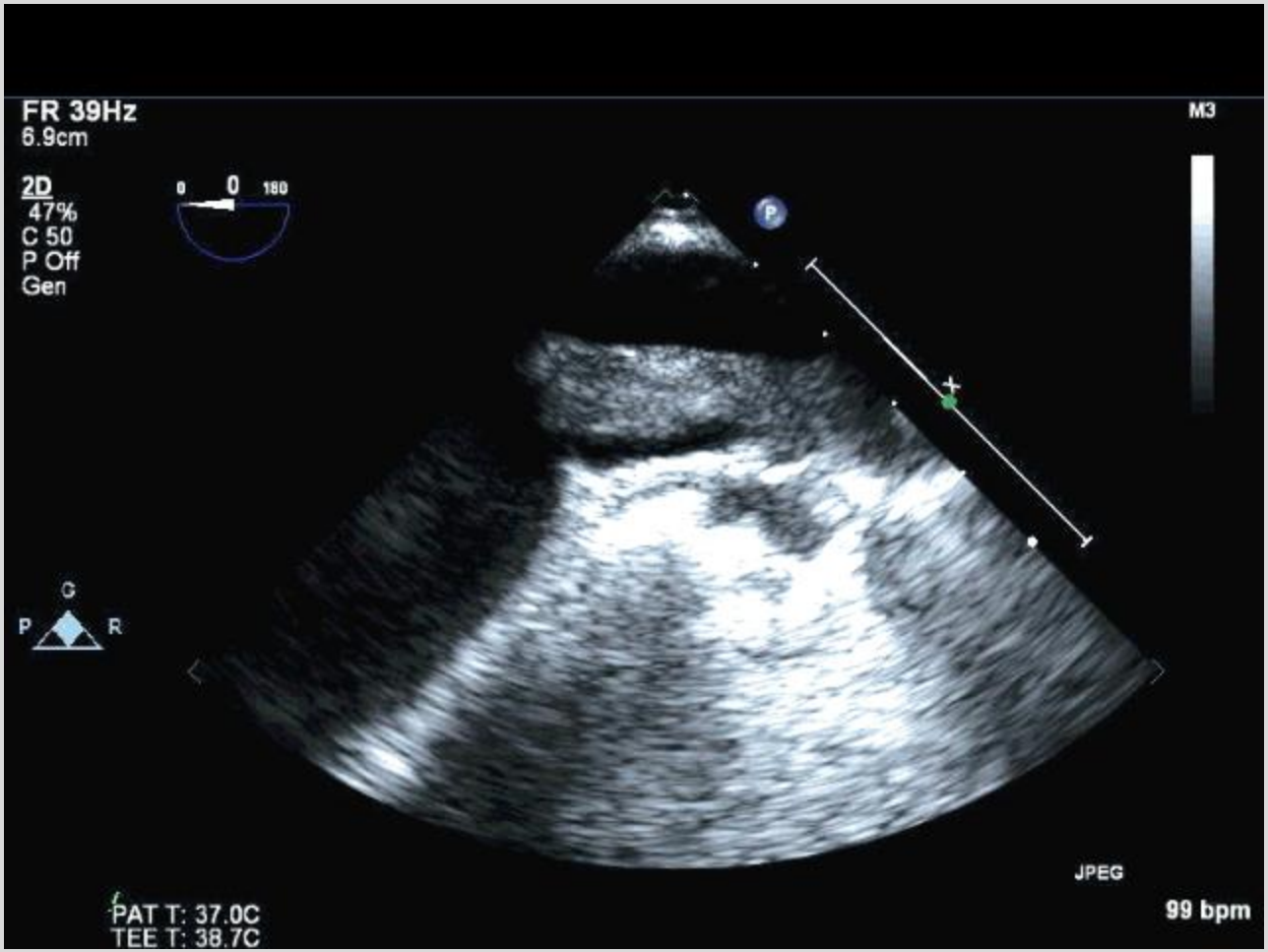
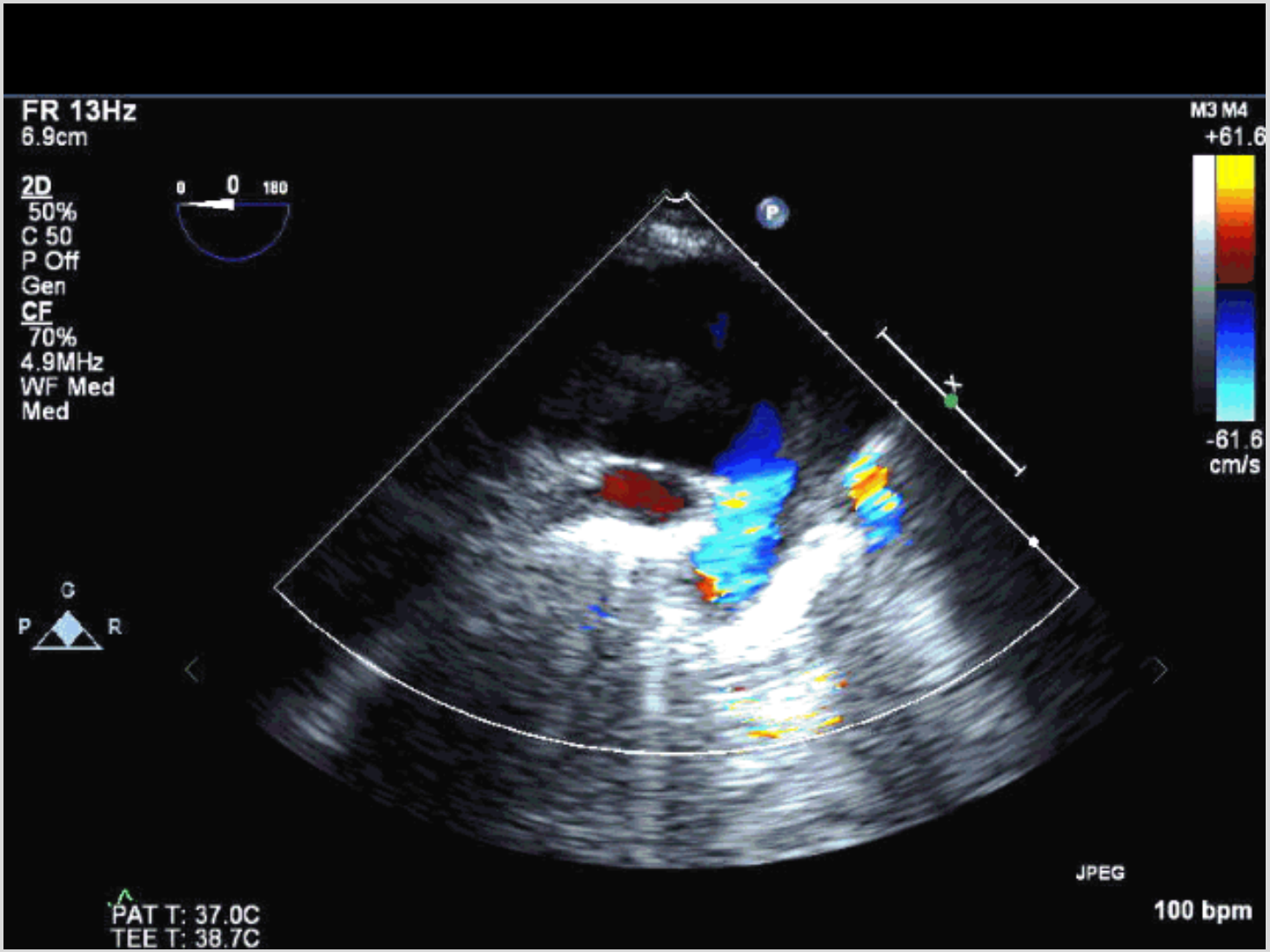
2.8
5.6
JPEG
92 bpm


FR 39Hz
6.9cm
2D
47%
C 50
P Off
Gen
0 0 180
M3
C
P
R
JPEG
99 bpm
PAT T: 37.0C
TEE T: 38.7C


FR 13Hz
6.9cm
2D
50%
C 50
P Off
Gen
CF
70%
4.9MHz
WF Med
Med
0 0 180
M3 M4
+61.6
-61.6
cm/s
C
P
R
JPEG
PAT T: 37.0C
TEE T: 38.7C
100 bpm

She is started on IV heparin.

24 HOURS LATER

SBP drops to 85 requiring 2mcg dopamine.

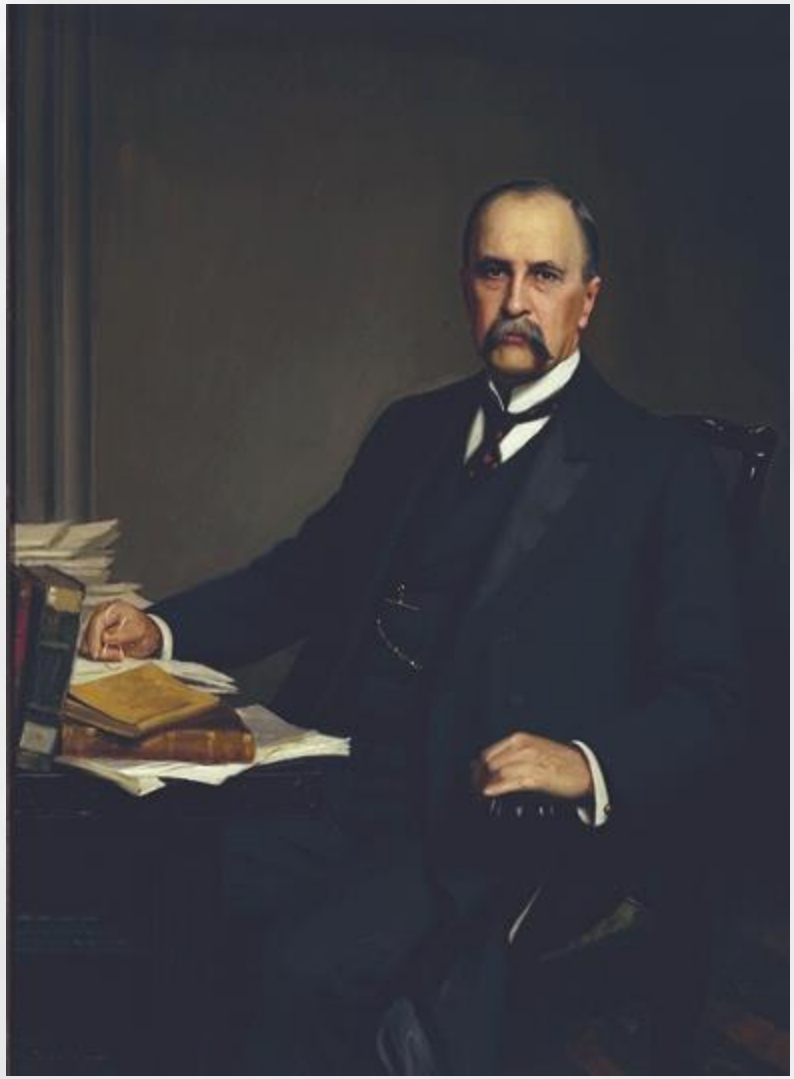
Repeat PCXR suggests, once again,
widened mediastinum

CTA OF CHEST

No ‘widened mediastinum’

Faced with indecision,
Osler told his trainees:

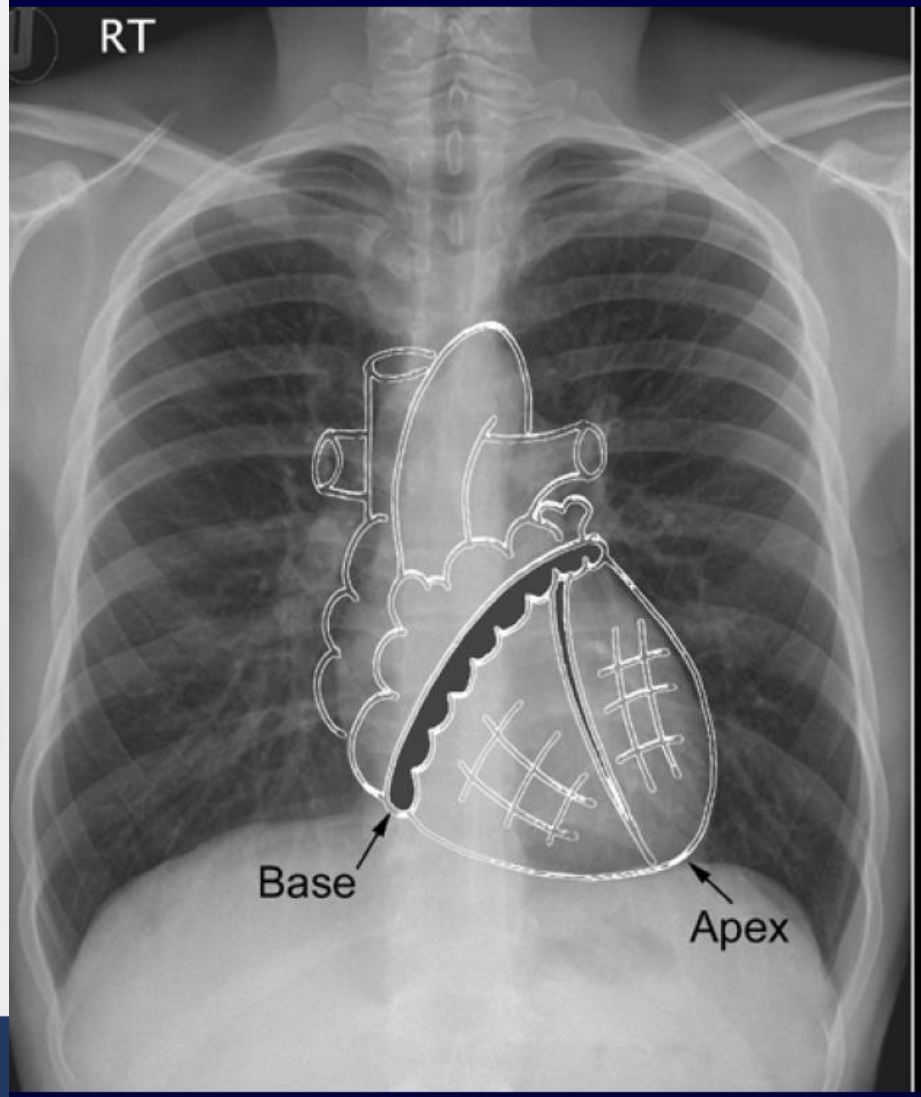
"Look wise, say nothing,
and grunt."

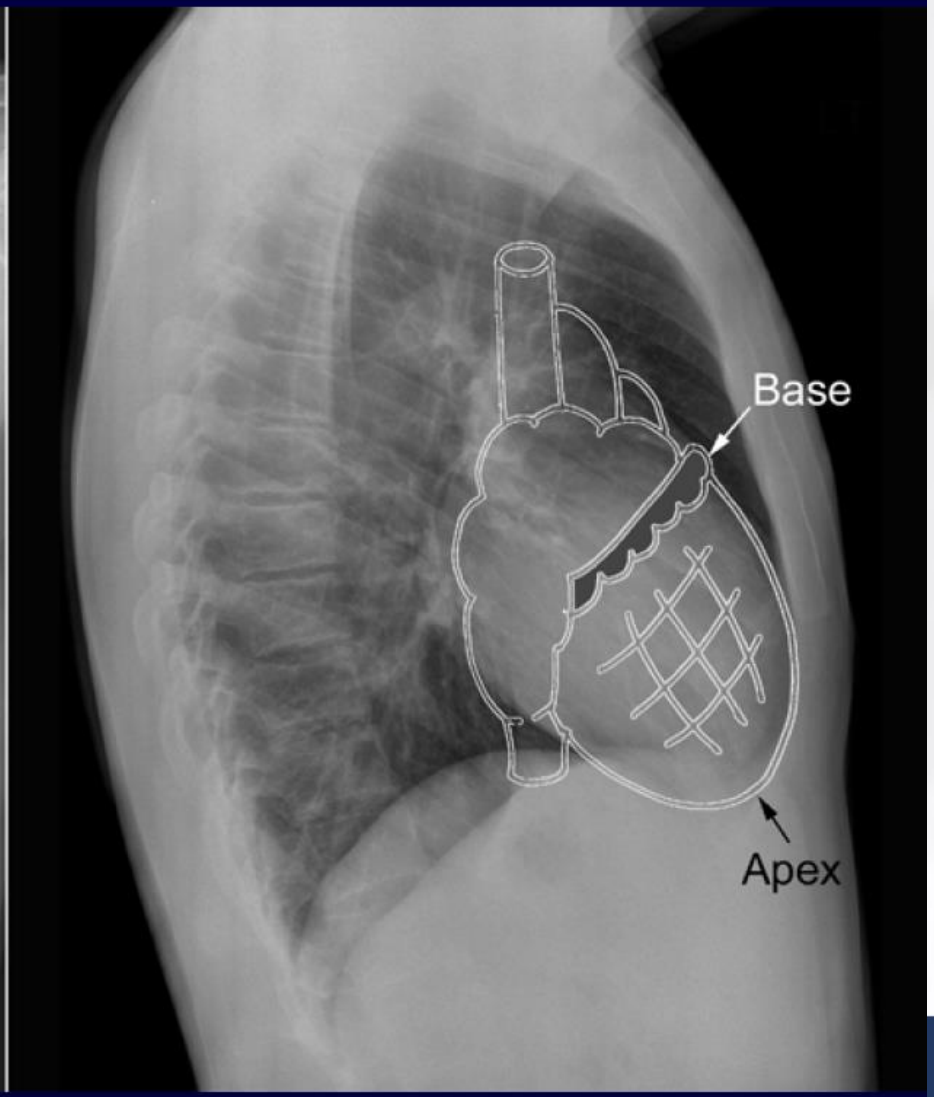


William Osler

Imaging is critically important to diagnosis and subsequent outcomes

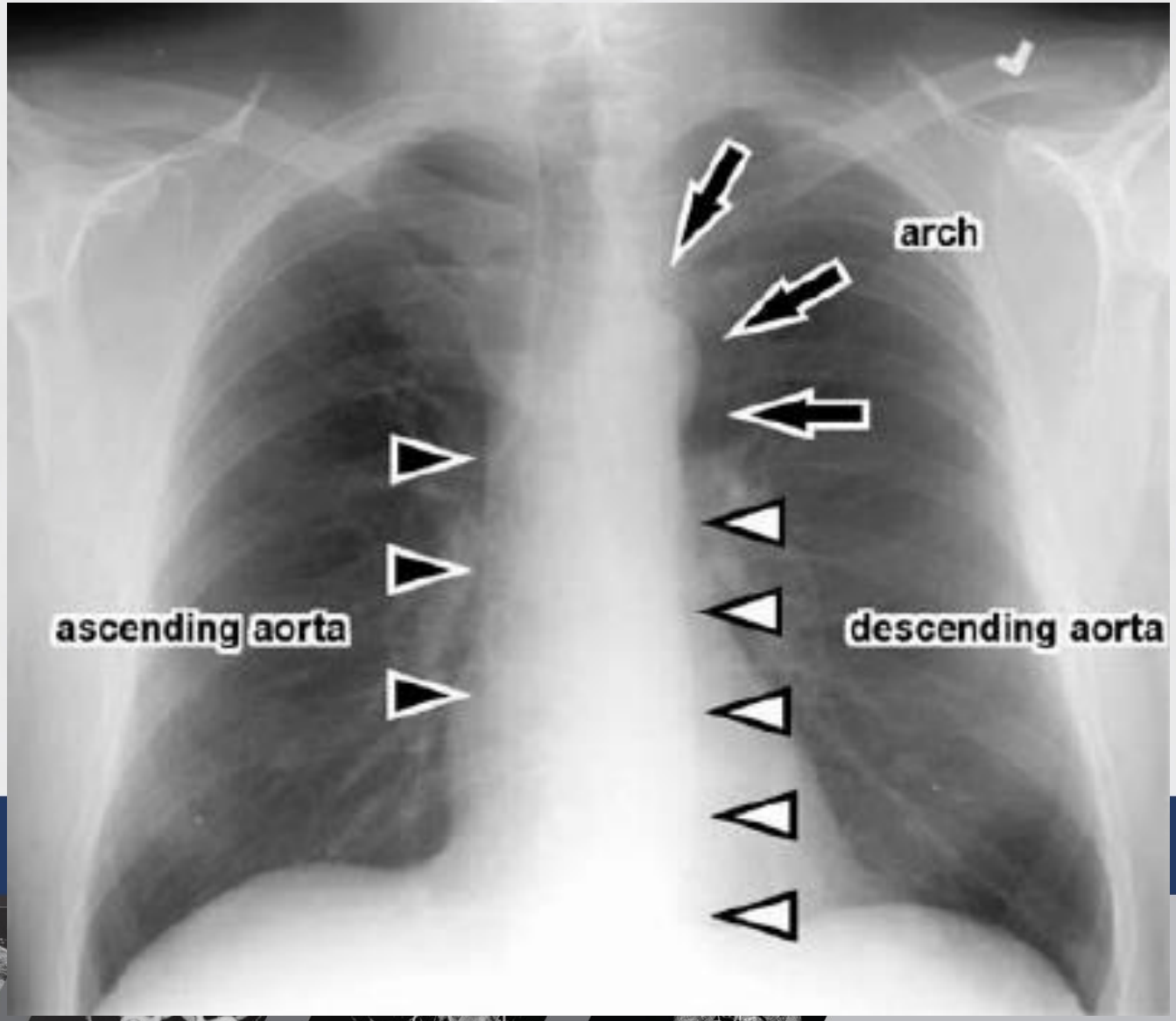

RT

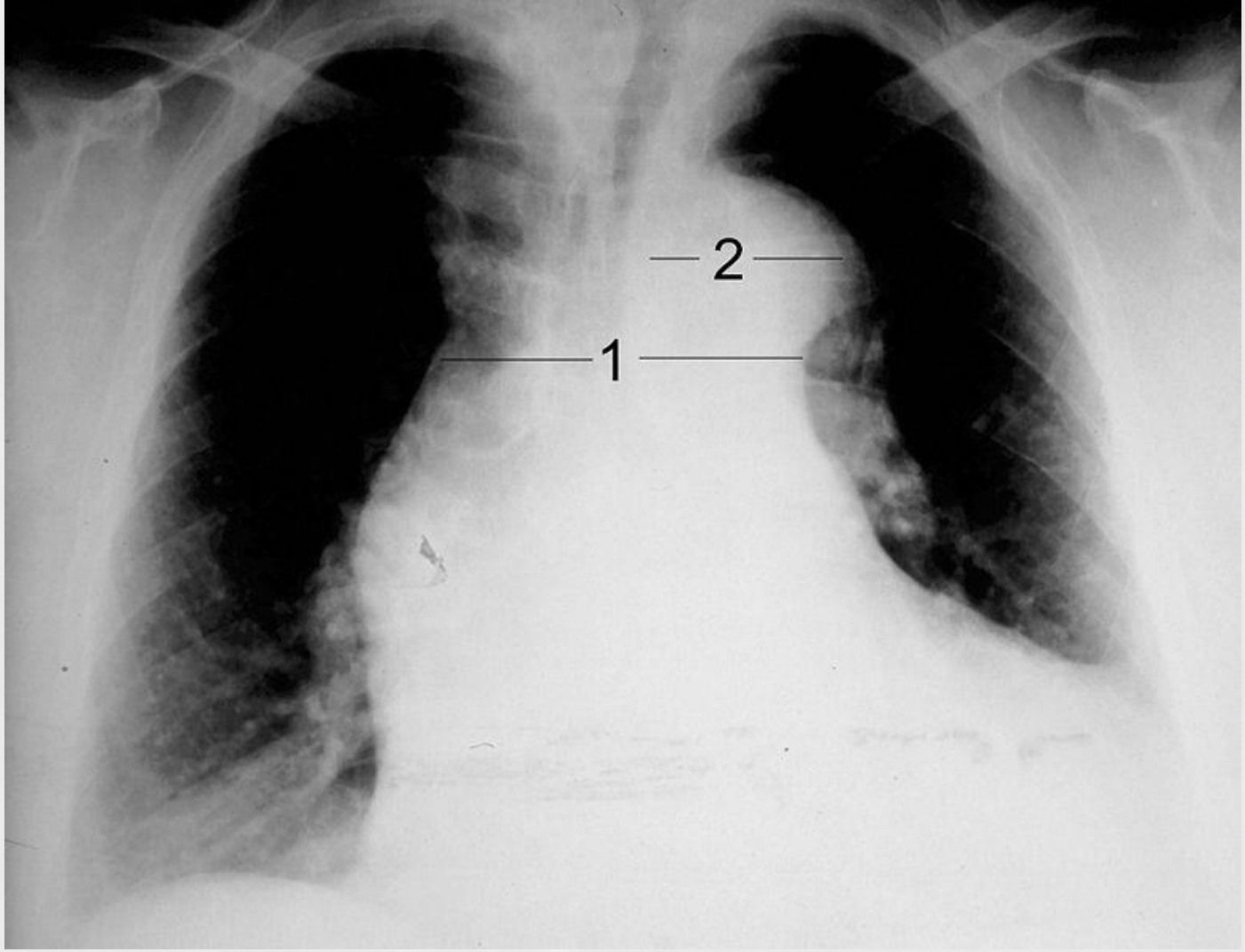




Is the heart big? Mediastinum? Aorta?

‘Widening of the mediastinum’ is dependent on many anatomic and imaging variables

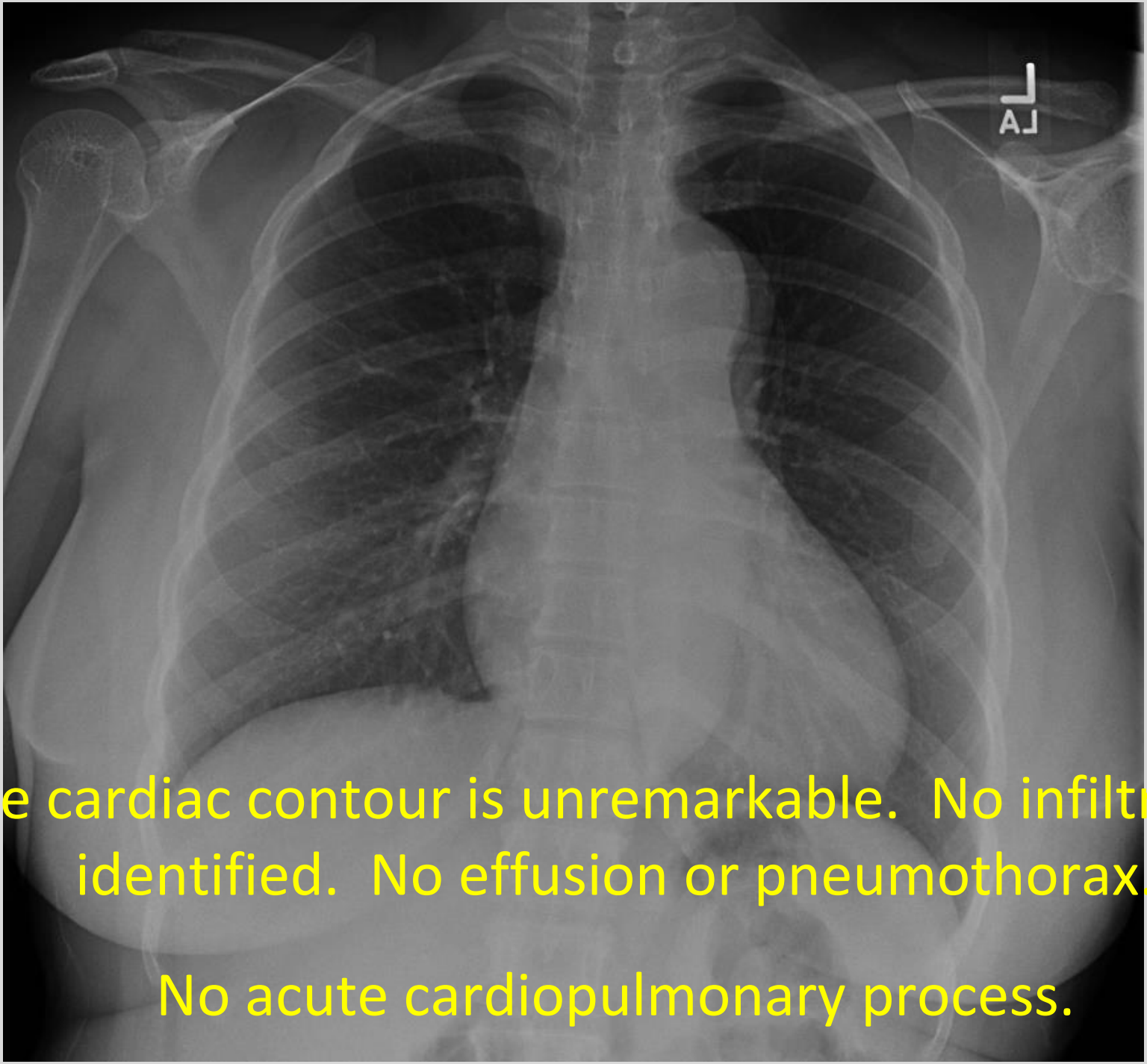




sensitivity only 67% for an ascending aortic dissection, even lower specificity-- many conditions & imaging variables can cause a widening of the mediastinum

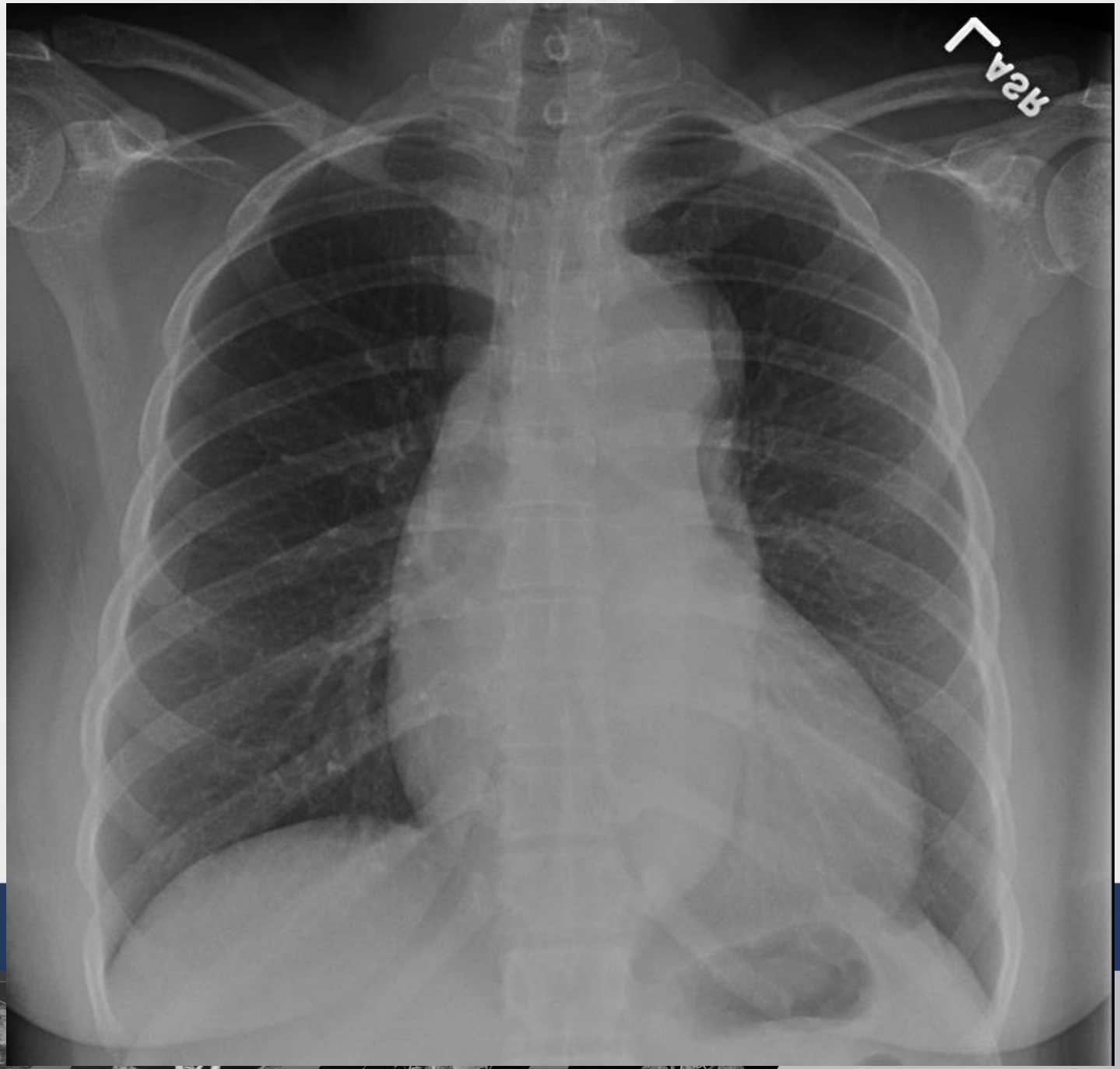
38 yo Female with several years of cough.

Self-referred to Aortic Clinic due to report of “tortuous aorta” on most recent CXR.

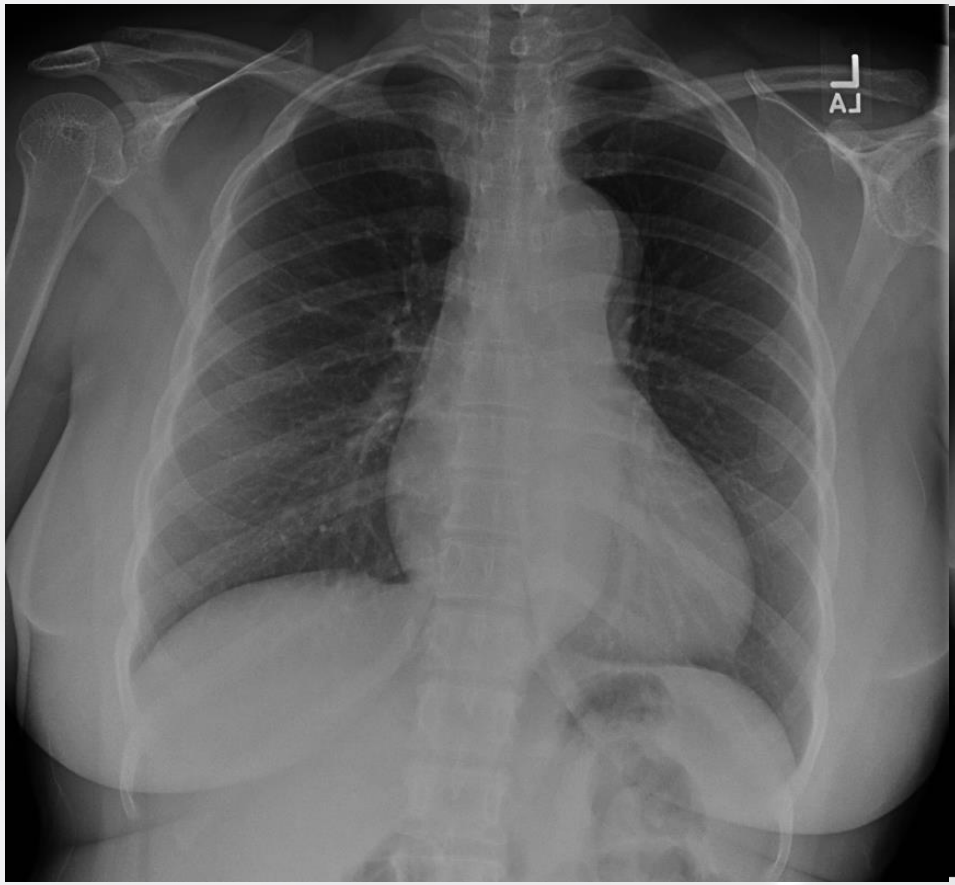


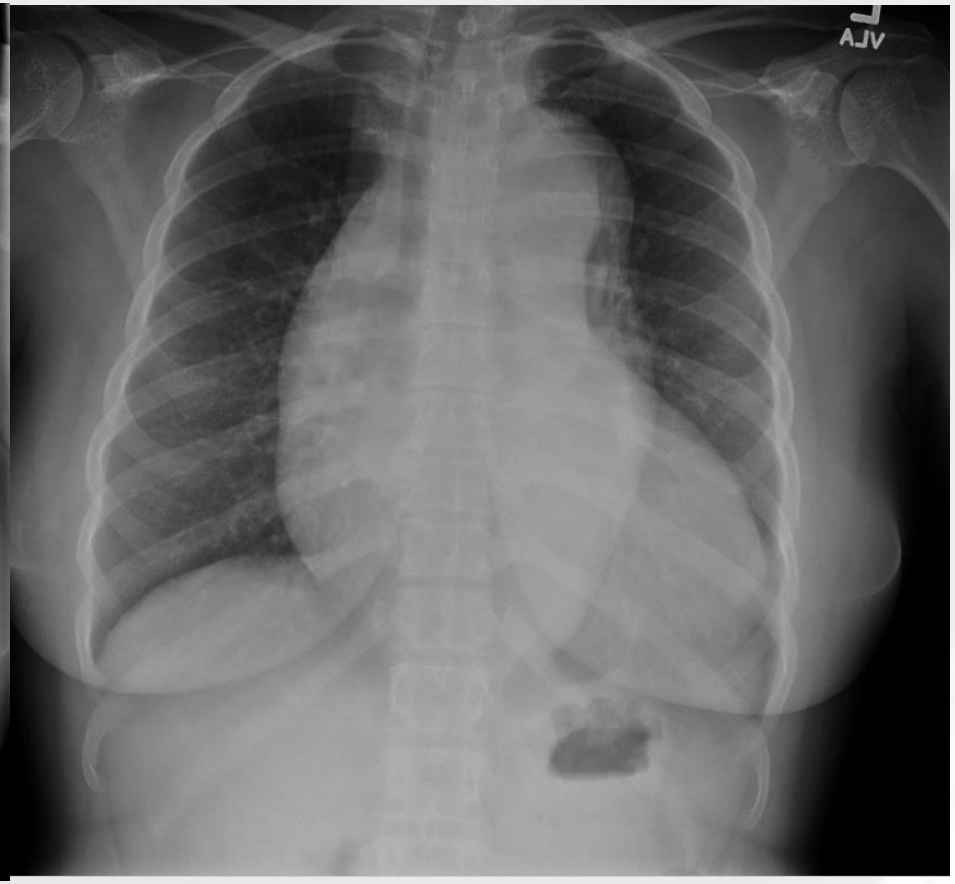
The cardiac contour is unremarkable. No infiltrate is identified. No effusion or pneumothorax.

No acute cardiopulmonary process.


L PA R


AJV





2008

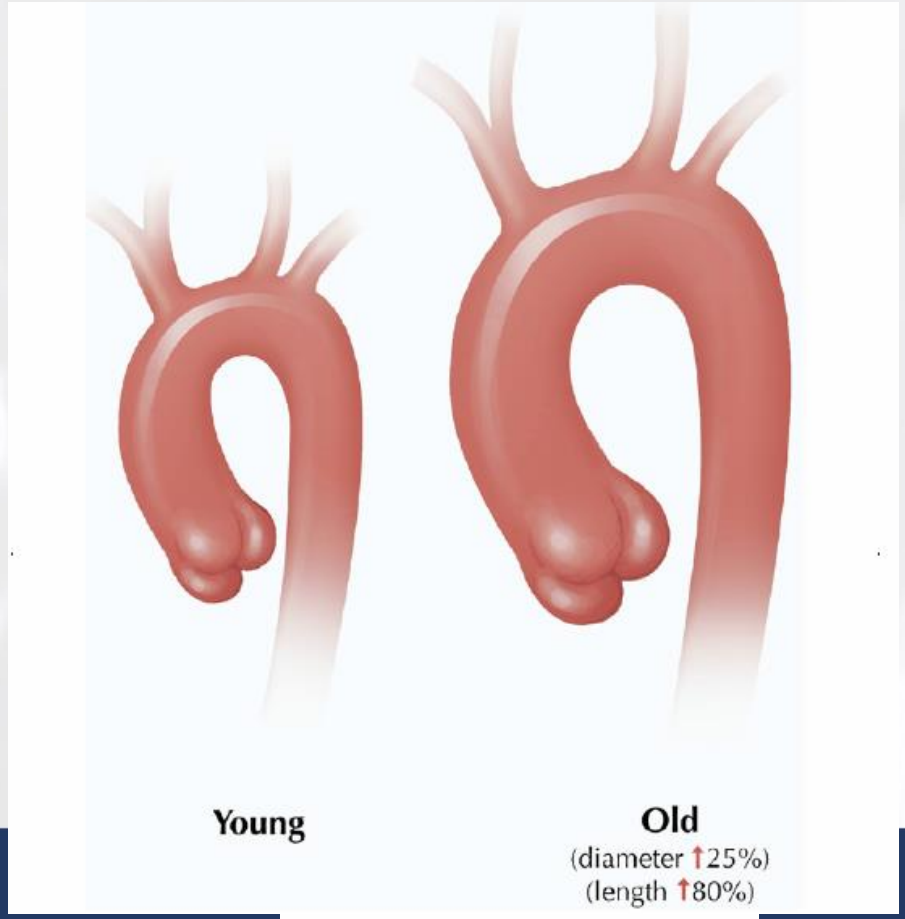
2017

Aortic Dimensions and Stiffness in Normal Adults

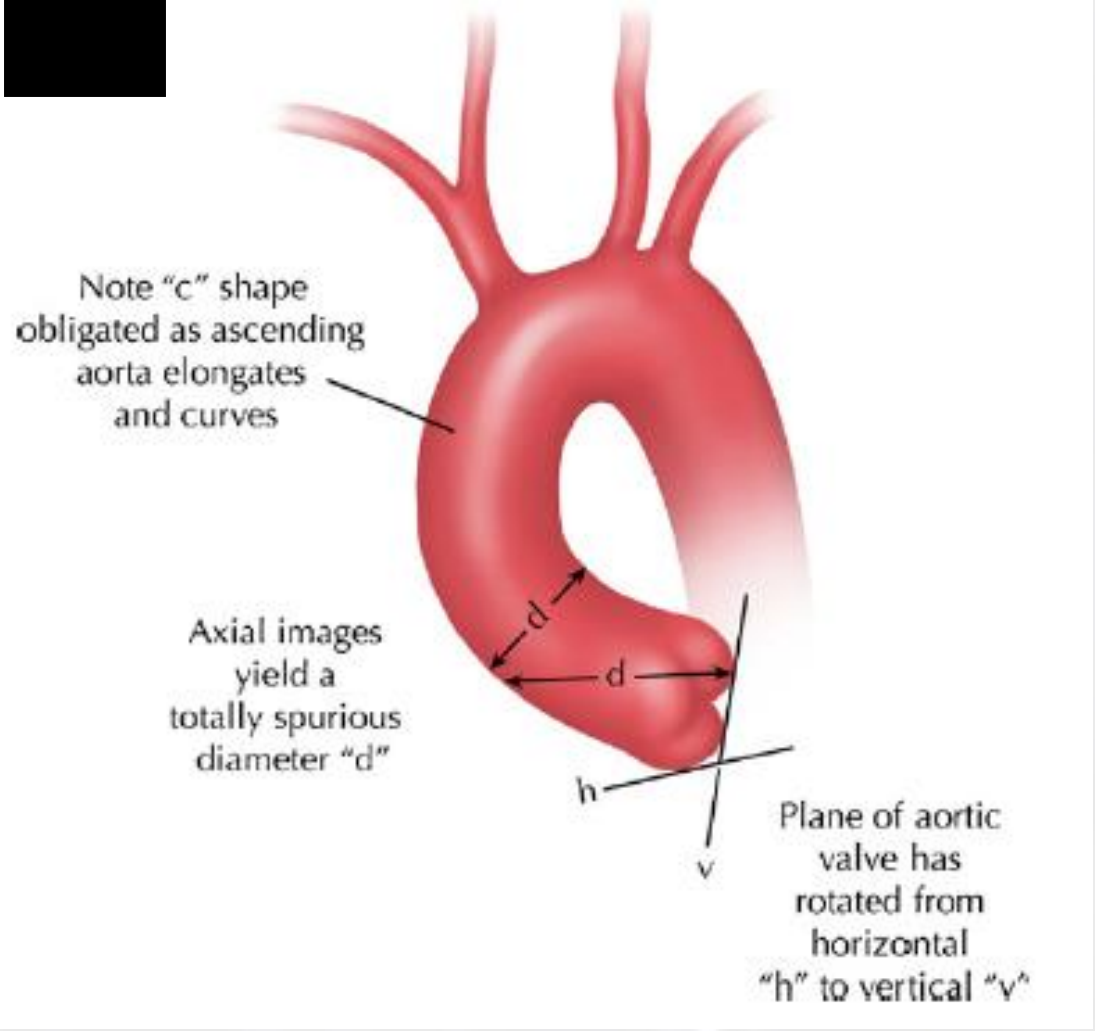
Michael O'Rourke, Alan Farnsworth, and John O'Rourke

J. Am. Coll. Cardiol. Img. 2008;1;749-751
doi:10.1016/j.jcmg.2008.08.002

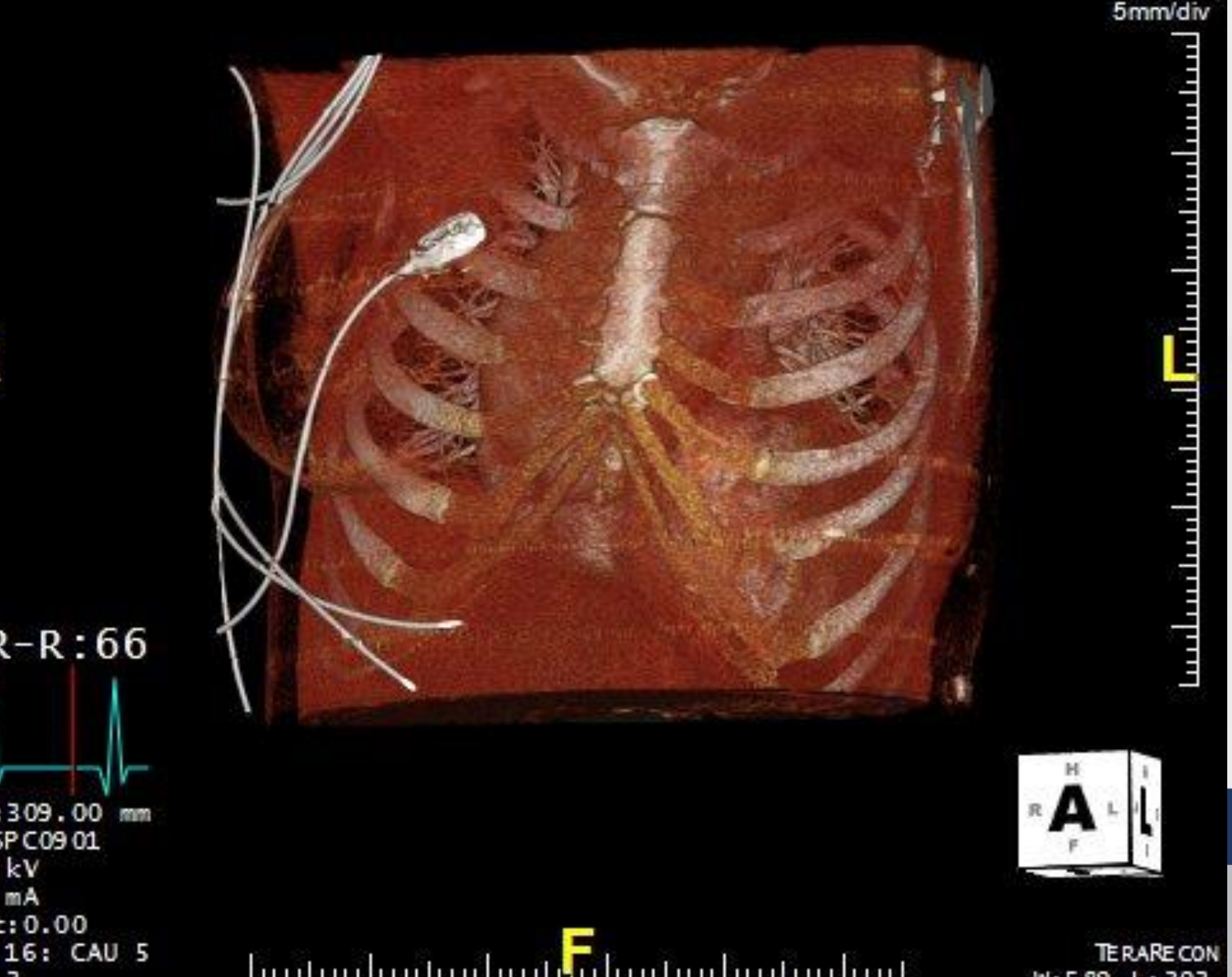
Length of the ascending aorta (aortic annulus to apex arch) increases 80% between the ages of 20 and 80 years of age



JACC cardiovascular Imaging



For the lengthening aorta to continue to fit in the prison of the thorax, it becomes more C shaped and tortuous (rightward unfolding of the aorta)


5mm/div
L
R-R:66
309.00 mm
SP C09 01
kV
mA
:0.00
16: CAU 5
F
TERARE CON


Age:39, F
Se:12
01/06/2015 1:32 PM
Kern:B26f
67 bpm, 66 % D, 75
C:Omnipaque
512x512
3D VR
Slab:150.00 mm
5mm/div
R
L
%R-R:66
FOV:309.00 mm
H
R
A
L
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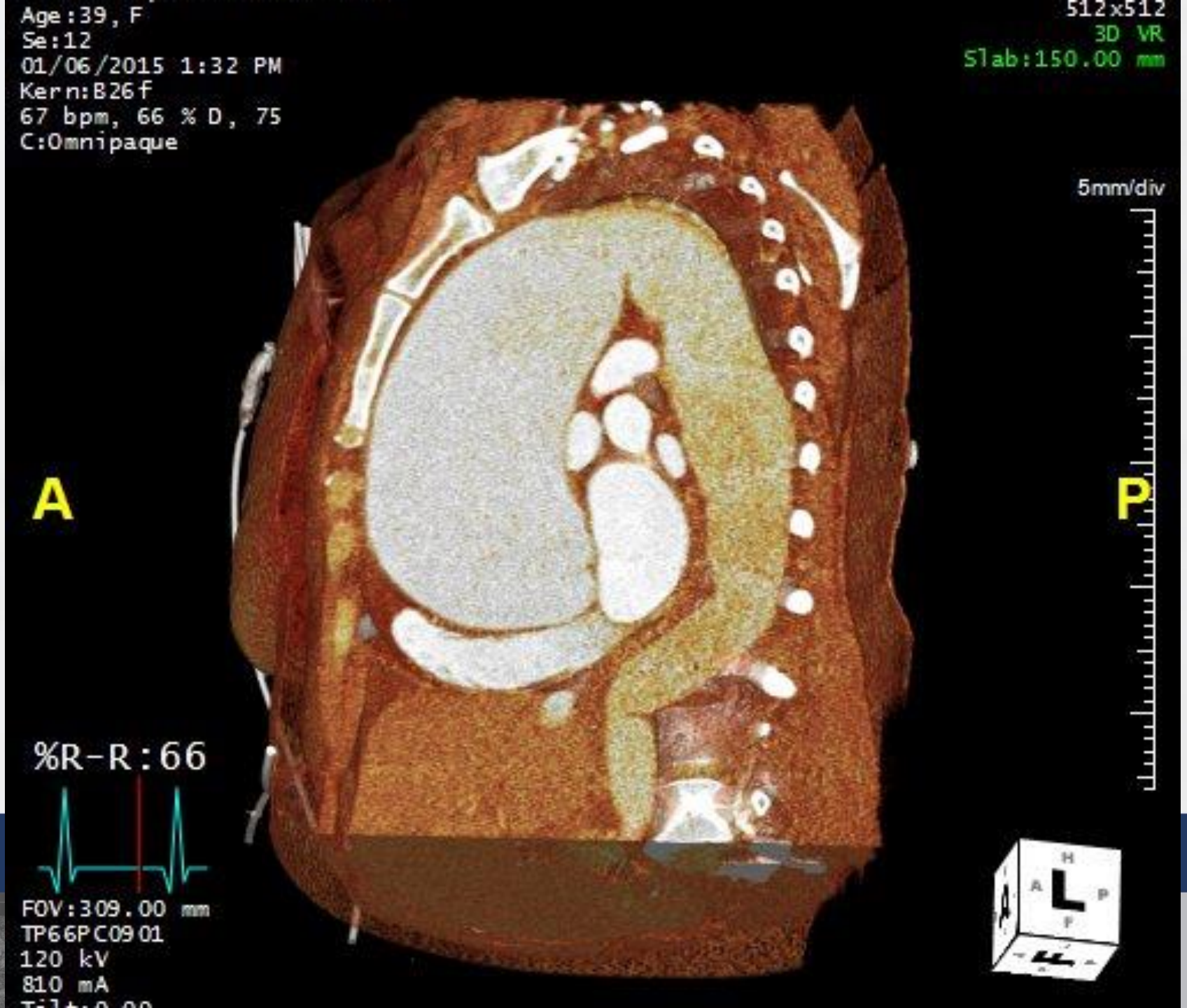
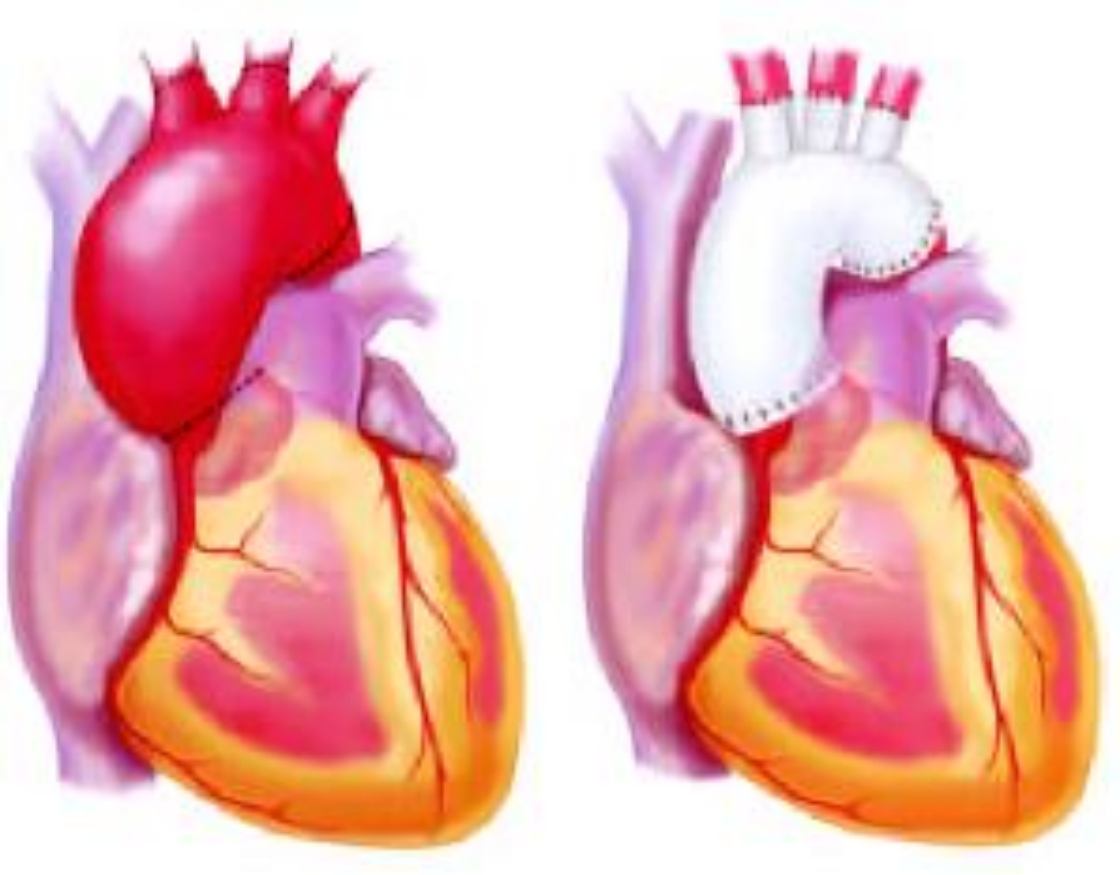
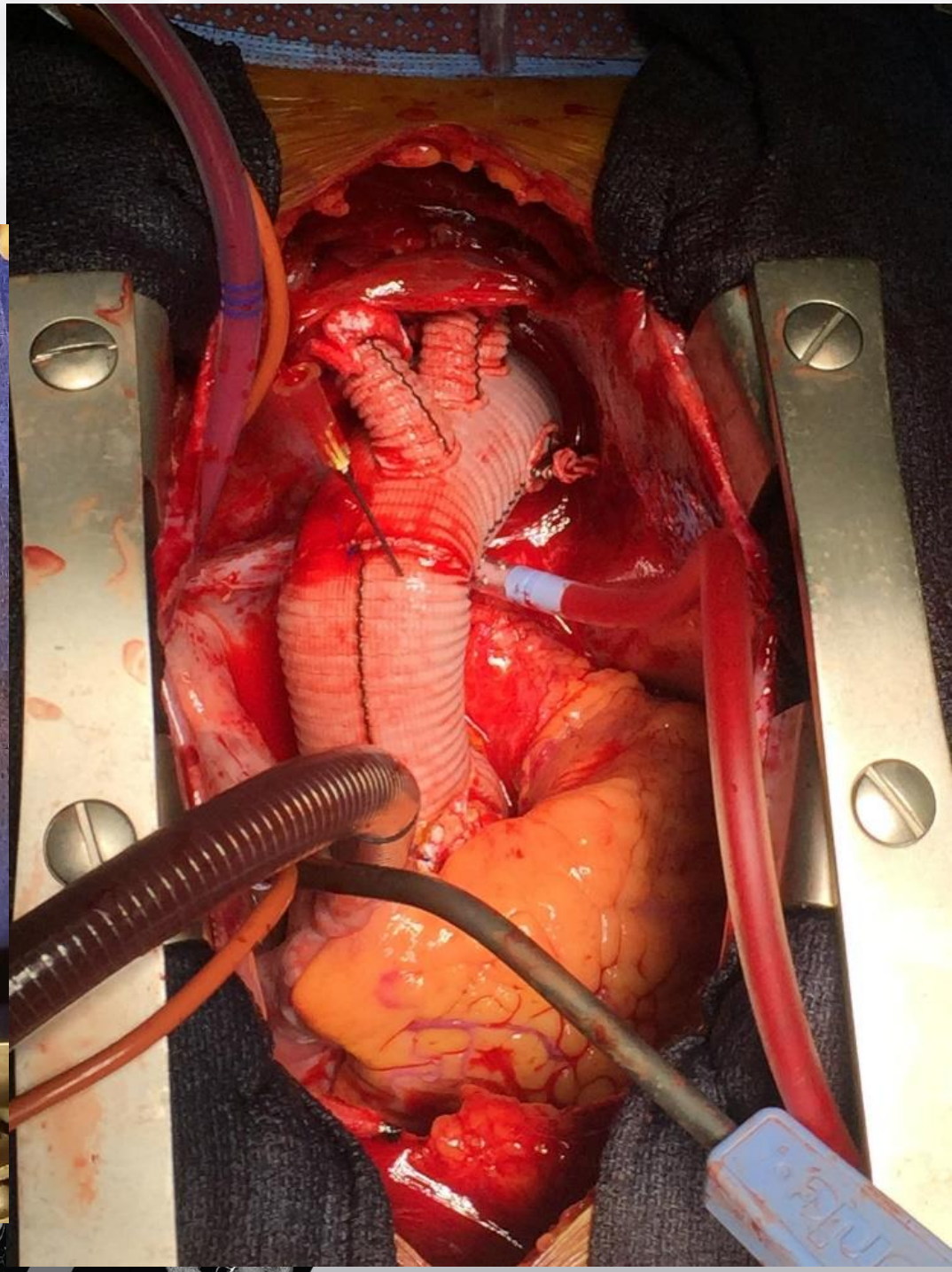

Age:39, F
Se:12
01/06/2015 1:32 PM
Kern:B26f
67 bpm, 66 % D, 75
C:Omnipaque
512x512
3D VR
Slab:150.00 mm
5mm/div
A
P
%R-R:66
FOV:309.00 mm
TP66PC0901
120 kV
810 mA

Aortic Surgery



Replacement of the diseased aortic section with a Dacron tube graft, sparing the aortic valve if possible



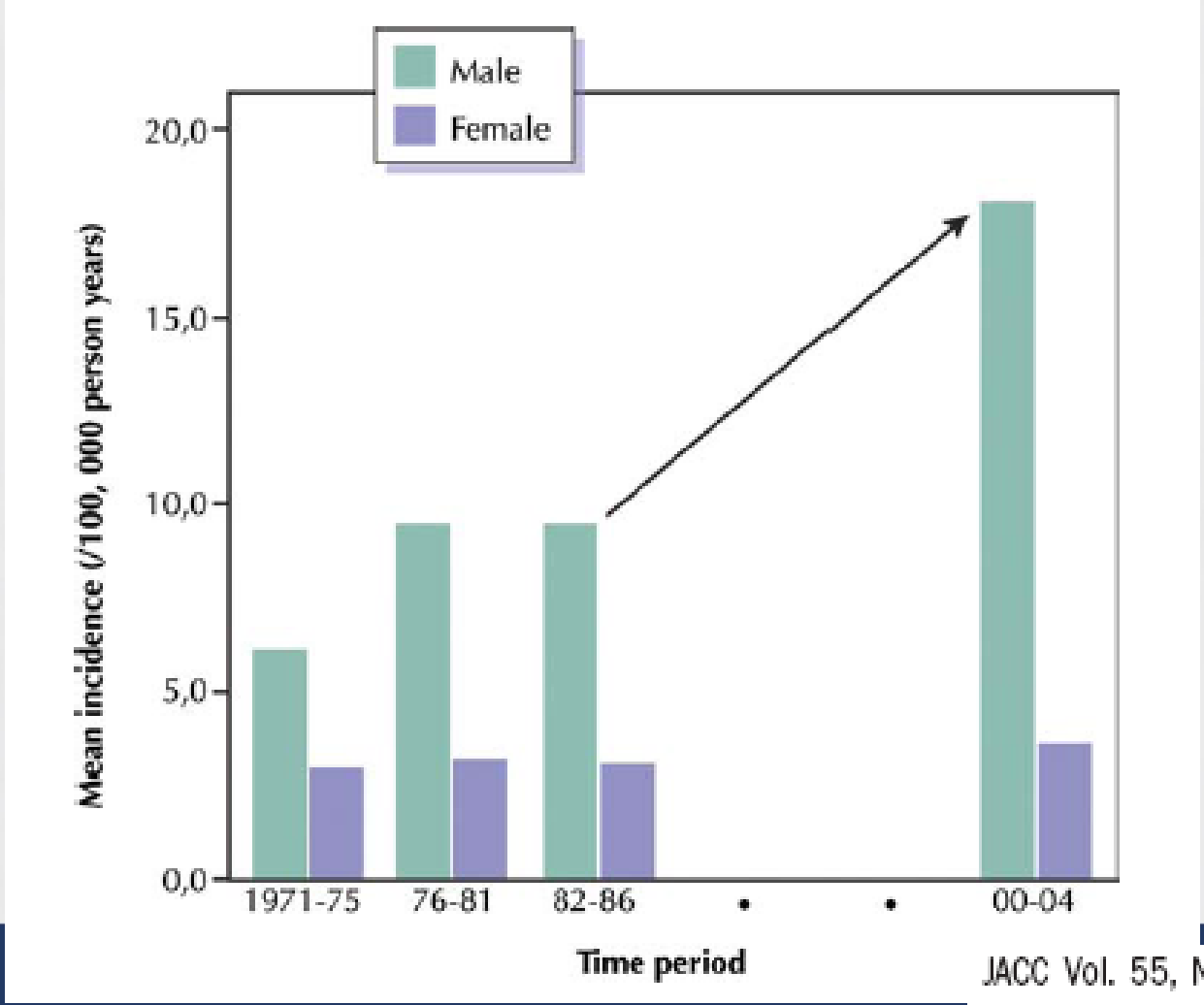
Critical Issues

If we wait for an Acute aortic syndrome, Late risk of death: Even young patients with Acute dissection have a 5-year survival of 50% after surgery due to residual events related to unresected dissected aorta -improved to **70%** in a formal aortic clinic.

This stresses the importance of

- identification those at risk and treatment prior to an acute presentation
- Long-term close follow-up with specialists after surgery

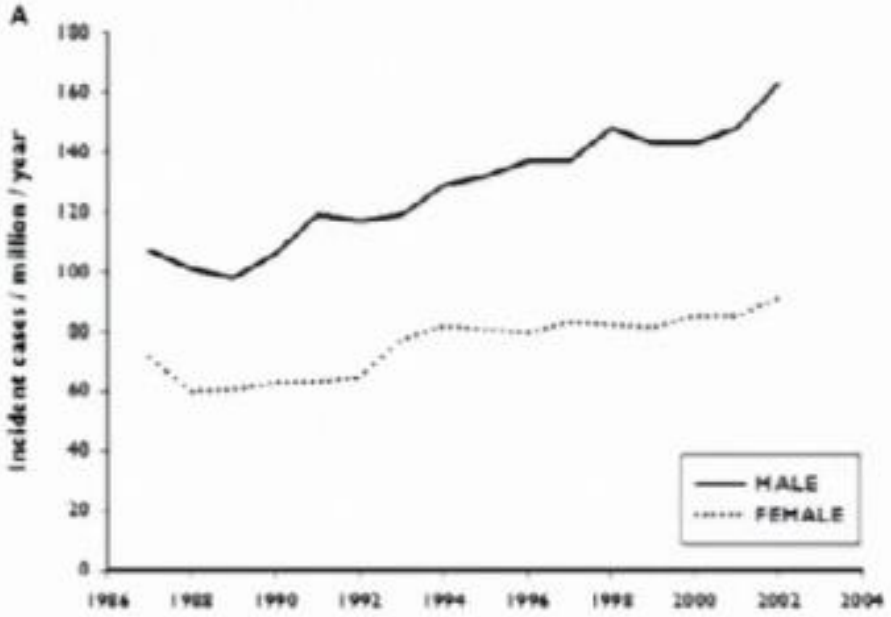
Thoracic Aneurysm: Increasing incidence with population aging



JACC Vol. 55, No. 9, 2010
March 2, 2010:841–57

True increasing incidence, not due to increased imaging

Incidence of thoracic aortic aneurysms and dissection is up



Operations for thoracic aortic aneurysms and dissection up

Olsson C. et al., Circulation 2006;114:2611-2618

Acute Cardiopulmonary symptoms

(chest pain, dysnea,)

ACS

STEMI
NSTEMI
Unstable Angina

AAS

Acute
Aortic
Syndromes

VTE

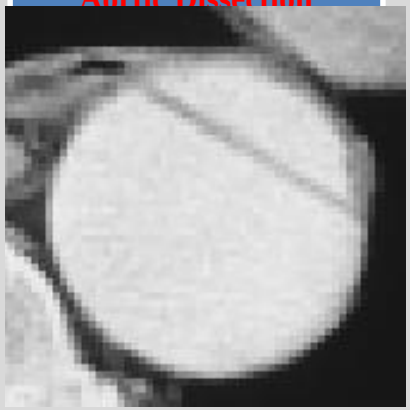
Venothrombo-
embolism

Tamponade

Esophageal Rupture

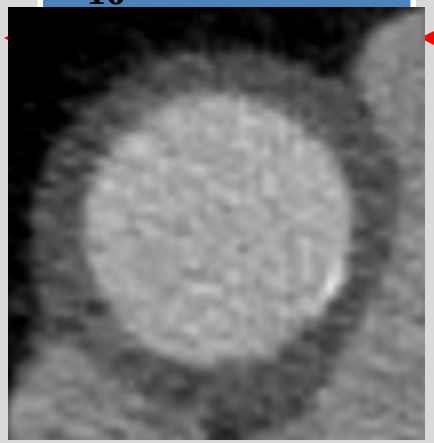
Spontaneous PTX

Aortic Dissection

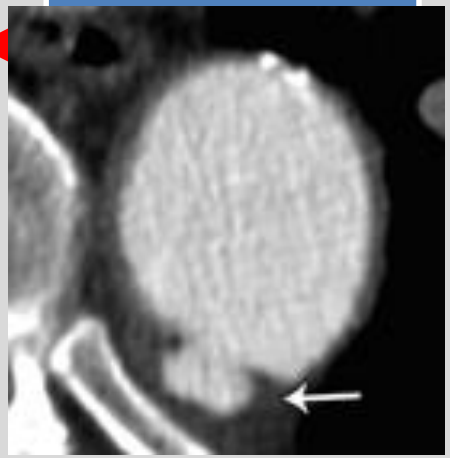


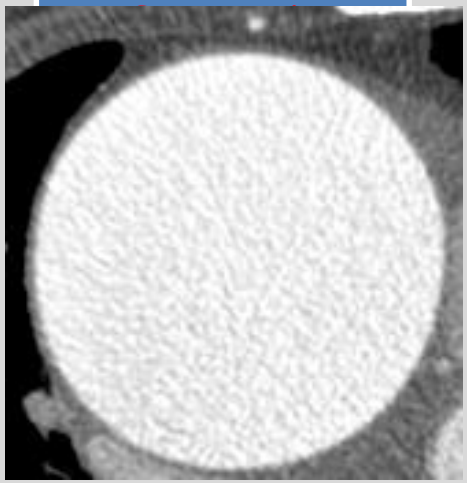
IMH

16



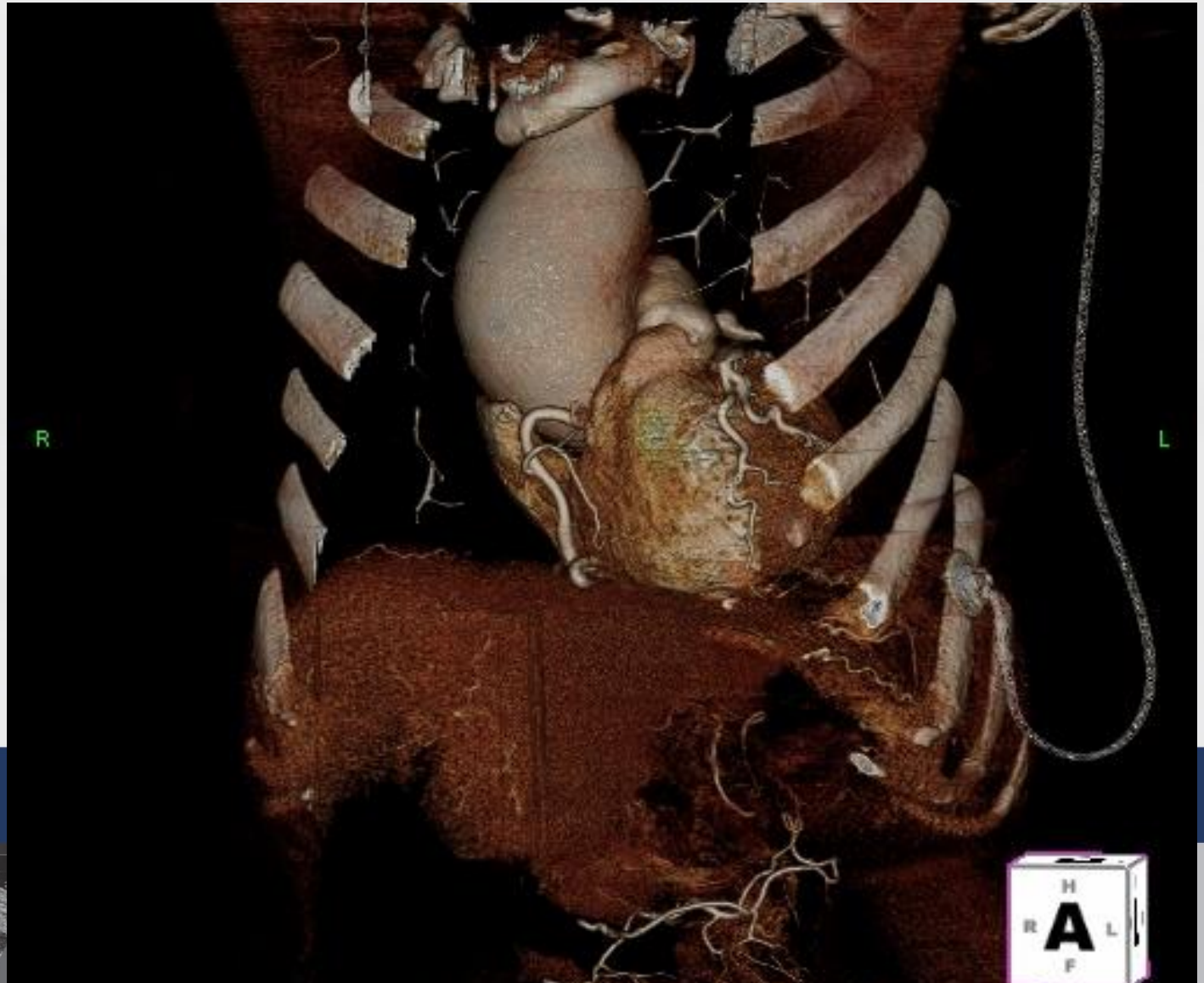
PAU



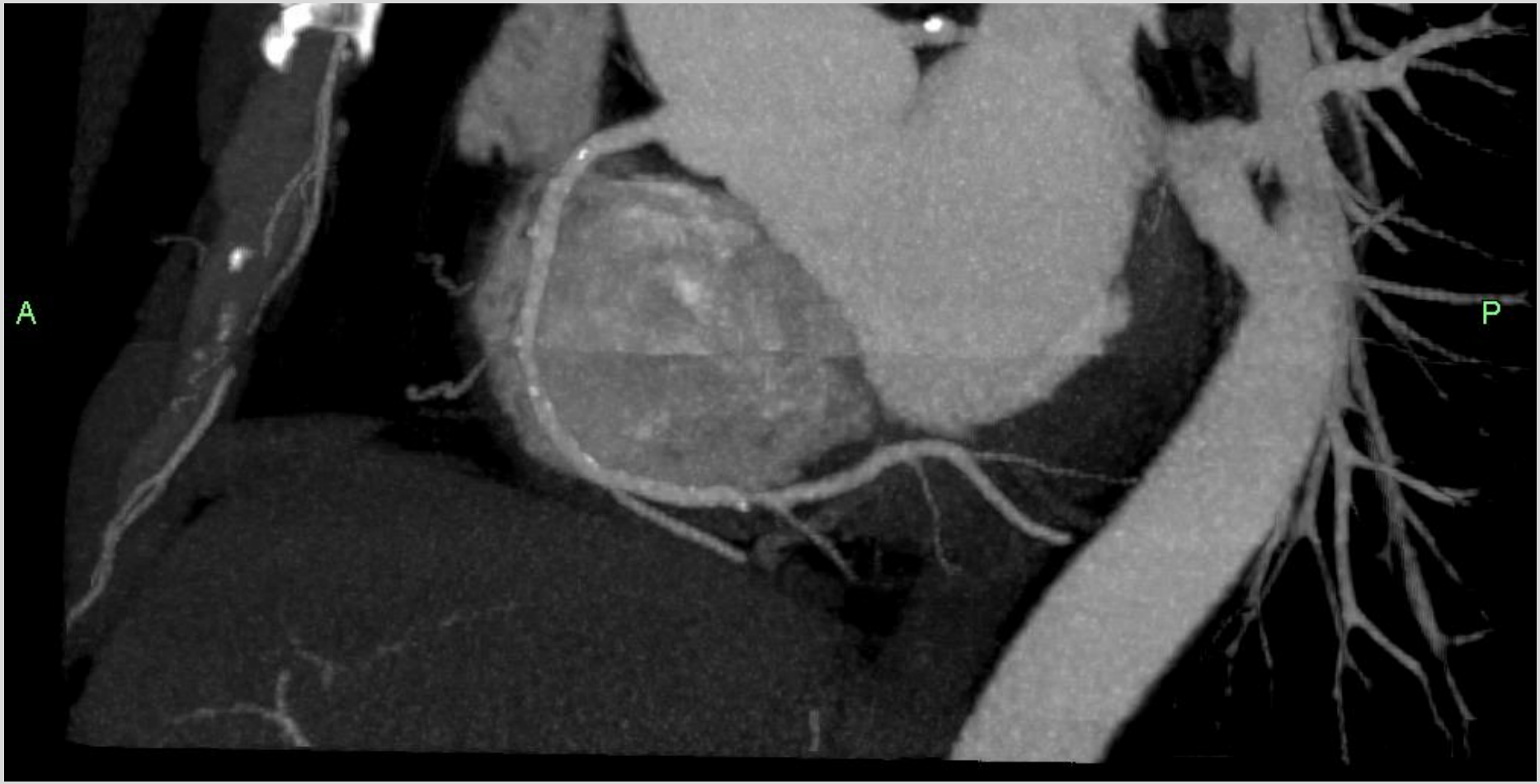


Two aortic imaging studies in the first 24 hours are necessary in the majority (70%) of patients

ECG-gated CT reveals the great vessels without artifacts & Coronaries



ECG-gated CT reveals the great vessels without artifacts & Coronaries




FFE / M
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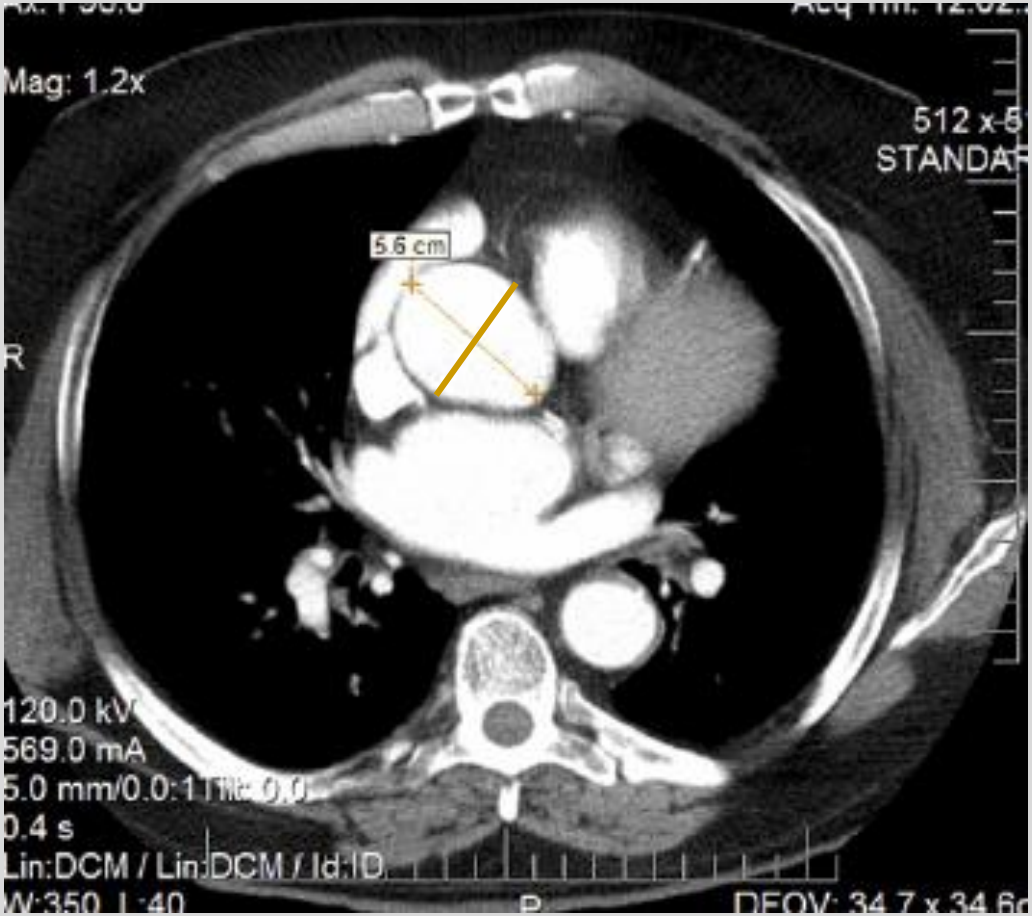
Advantages and disadvantages

Imaging modality	Advantages	Limitations
TTE	• Available and cost effective • Lack of radiation or contrast • Good visualization of proximal aorta	• Limited visualization of distal aorta • May not account for asymmetry • Image quality dependent on operator and patient factors
TEE	• Visualization of more distal segments • Lack of radiation or contrast • Can be used intra-operatively	• Invasive procedure • Sector width of 90° limits orientation • Blind spot may limit distal assessment
CT	• Excellent resolution • True short-axis measurements • Assessment of aortic wall pathology	• Requires ionizing radiation • Contrast dye exposure • Limited valvular assessment
MRI	• Good spatial and temporal resolution • True short-axis measurements • Allows tissue characterization and valvular/ ventricular function assessment • Aortic imaging can be done without contrast	• Cannot be performed in patients with cardiac implantable electronic devices • More prone to artifacts • Dependent on patient factors (ability to breath hold and heart rate)

Question A CT chest report returns " The ascending aorta measures **"4.2 cm X 5.6 cm"**

Which number do you use to determine whether to refer the patient for surgery?



Question A CT chest report returns " The ascending aorta measures **"4.2 cm X 5.6 cm"**

Which number do you use to determine whether to send the patient to surgery?

A. Average the two numbers together

B. Use the lower of the two numbers in management, to prevent sending the patient for surgery too early

C. Use the higher of the two numbers, to prevent sending the patient for surgery too late

D. None of the above

Insist on repeat measurements perpendicular to flow at multiple points within the aorta, indexed to body surface area to refine the risk

ACCF/AHA Guideline

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

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

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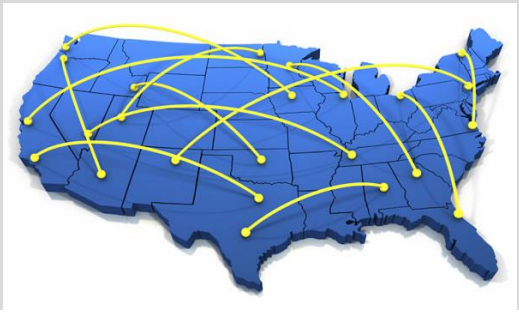
J Am Coll Cardiol April 6, 2010

1. The location at which the aorta is abnormal (see Section 2).
2. The maximum diameter of any dilatation, measured from the external wall of the aorta, perpendicular to the axis of flow, and the length of the aorta that is abnormal.
3. For patients with presumed or documented genetic syndromes at risk for aortic root disease measurements of aortic valve, sinuses of Valsalva, sinotubular junction, and ascending aorta.
4. The presence of internal filling defects consistent with thrombus or atheroma.
5. The presence of IMH, PAU, and calcification.
6. Extension of aortic abnormality into branch vessels, including dissection and aneurysm, and secondary evidence of end-organ injury (eg, renal or bowel hypoperfusion).
7. Evidence of aortic rupture, including periaortic and mediastinal hematoma, pericardial and pleural fluid, and contrast extravasation from the aortic lumen.
8. When a prior examination is available, direct image to image comparison to determine if there has been any increase in diameter.

IMH indicates intramural hematoma; and PAU, penetrating atherosclerotic ulcer.

Careful imaging and measuring is time-consuming BUT **accurate size** is, beyond symptoms, the best intervention criterion in 2018



Aortic Location	Measurement (orthogonal to axis of flow)
Aortic Annulus	
Sinus of Valsalva	
Sinotubular Ridge	
Distal Ascending prior to 1st arch vessel	
Proximal Descending after last arch vessel (Isthmus)	
Mid descending at level of left atrium	
Distal descending at aortic hiatus	
Maximum Aorta Dimension: **Ascending Aorta** **Descending Aorta**	
Body Surface Area (Dubois) http://parameterz.blogspot.com/2008/11/ascending-aorta-z-scores.html	m^2
Aortic Size Index (ASI)	**cm/m^2**

ASI Interpretation Guide*

Risk Category (combined endpoint of rupture, dissection, or death)	Aortic Size Index (ASI)
Low risk (4% per year)	<2.75 cm/m^2
Moderate risk (8% per year)	2.75–4.24 cm/m^2
High risk (20% per year)	>4.25 $cm/m\ m^2$

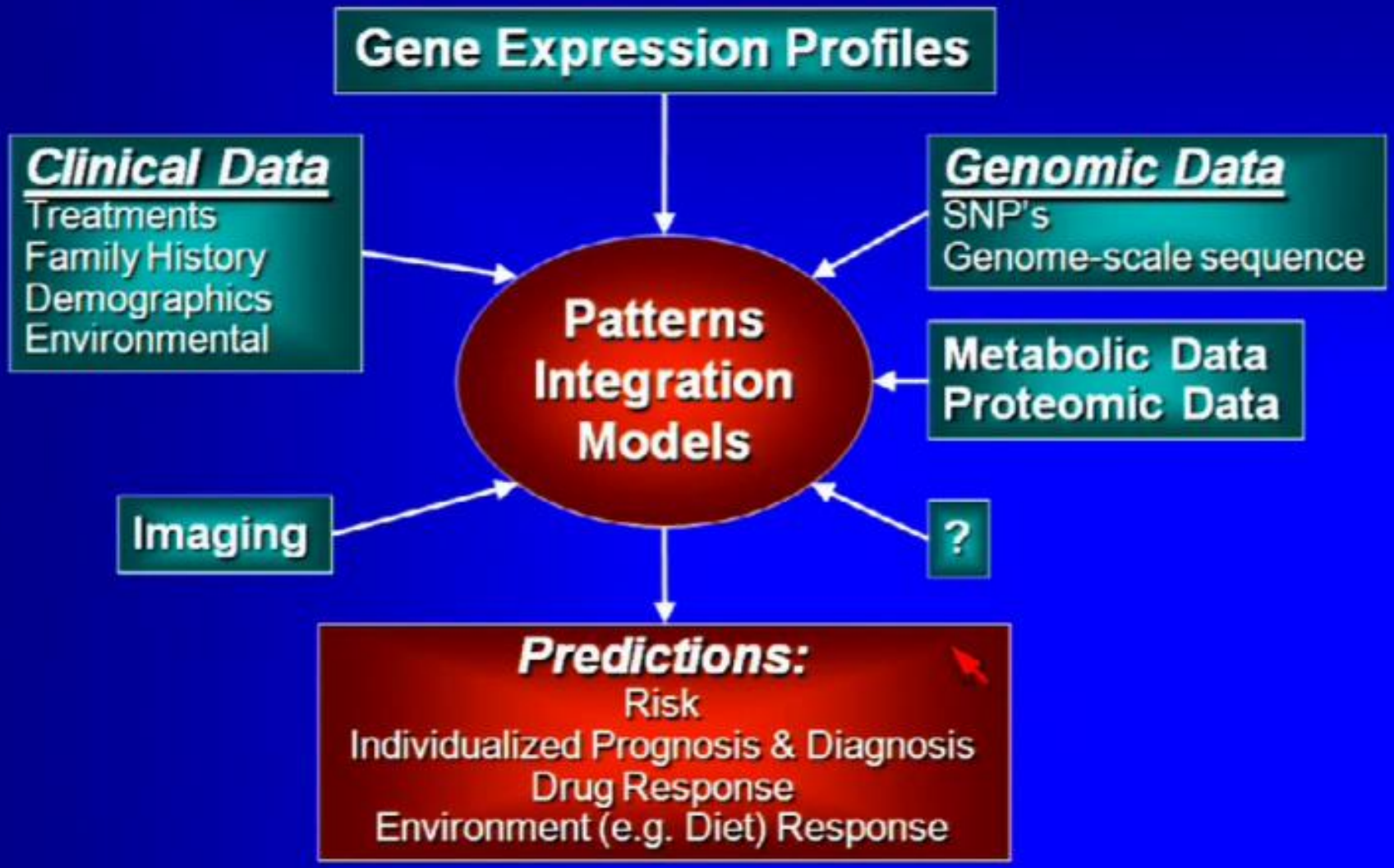
(*"Novel Measurement of Relative Aortic Size Predicts Rupture of Thoracic Aortic Aneurysms" Davies, et al Ann Thorac Surg 2006;81:169 –77)

2010 Guidelines on Thoracic Aortic Disease

Table 17. Suggested Follow-Up of Aortic Pathologies After Repair or Treatment

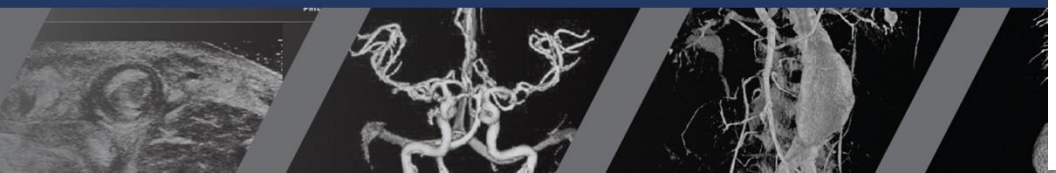
Pathology	Interval	Study
Acute dissection	Before discharge, 1 mo, 6 mo, yearly	CT or MR, chest plus abdomen TTE
Chronic dissection	Before discharge, 1 y, 2 to 3 y	CT or MR, chest plus abdomen TTE
Aortic root repair	Before discharge, yearly	TTE
AVR plus ascending	Before discharge, yearly	TTE
Aortic arch	Before discharge, 1 y, 2 to 3 y	CT or MR, chest plus abdomen
Thoracic aortic stent	Before discharge, 1 mo, 2 mo, 6 mo, yearly 0r 30 days*	CXR, CT, chest plus abdomen
Acute IMH/PAU	Before discharge, 1 mo, 3 mo, 6 mo, yearly	CT or MR, chest plus abdomen

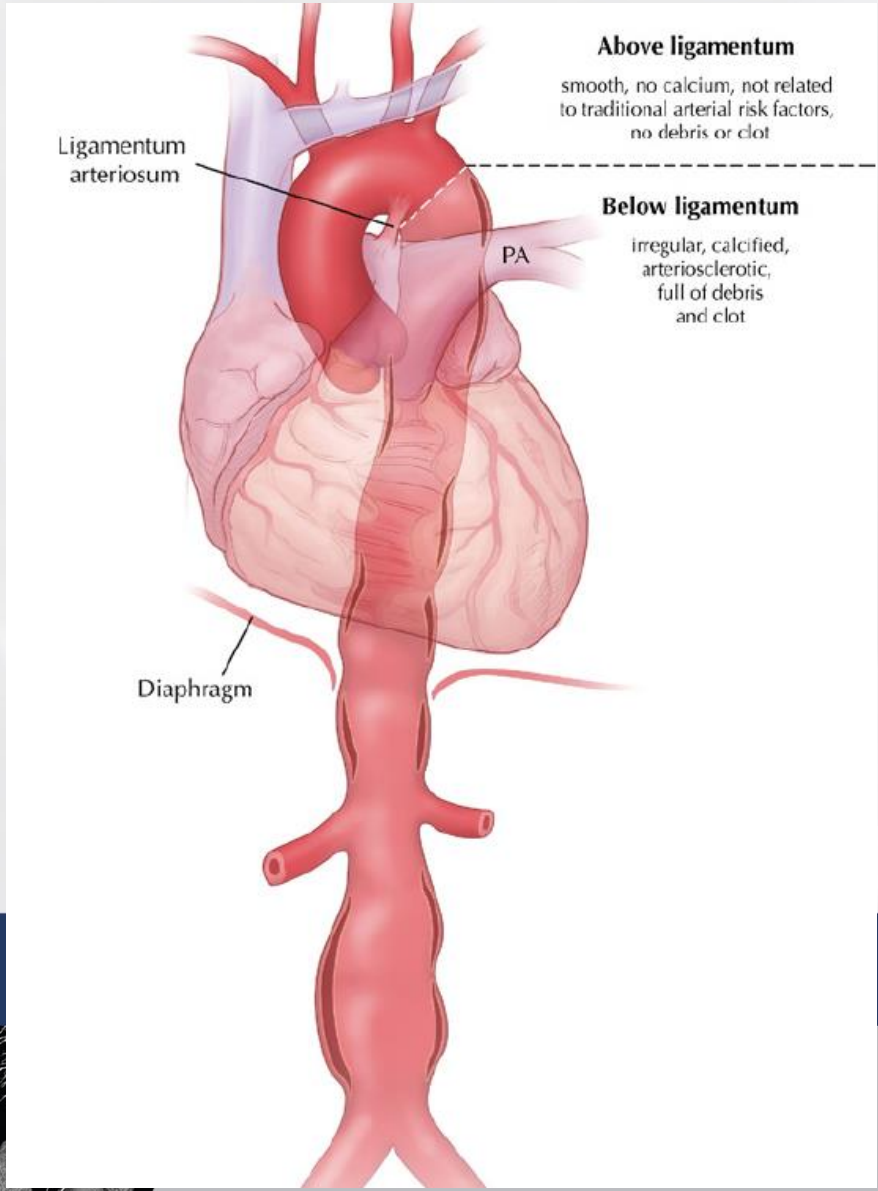
Where is the Future?



Hypertension is one risk factor for aortic aneurysms and for acute aortic syndromes

- Risk factors for descending aorta aneurysm & abdominal AAA is similar to those for atherosclerosis
- Risk factors for ascending aneurysms are 95% time unknown





Etiology of Thoracic Aortic Aneurysms

Etiology	Comments
Connective tissue disorders	
Marfan syndrome	Mutation in the gene *FBN1*; aneurysms typically involve the aortic root at the sinus level.
Ehlers-Danlos syndrome type IV, vascular type	Associated with mutations in the gene for type III procollagen, *COL3A1*.
Loeys-Dietz syndrome	Mutations in the genes *TGFBR1* or *TGFBR2*; associated with arterial tortuosity and multiple arterial aneurysms.
Congenital conditions	
Bicuspid aortic valve	Aneurysms most often involve the ascending aorta, less often the root at the sinus level.
Turner syndrome	Often associated with a bicuspid aortic valve.
Genetic	
Familial thoracic aortic aneurysm syndrome	Known mutations are identified in 20% of families, and include *ACTA2* (14%), *TGFBR2* (4%), and *MYH11* (1%).
Atherosclerosis	Typically involves the descending aorta.
Vasculitis	
Takayasu arteritis	May cause stenotic lesions as well as aneurysms. Affects younger population. Near universal left subclavian artery involvement.
Giant cell arteritis	Affects older population, particularly women, and may include symptoms of polymyalgia rheumatica.
Nonspecific (idiopathic) aortitis	Found on pathological analysis of aortic specimen at time of surgery.
Other autoimmune conditions (e.g., Behçet disease, systemic lupus erythematosus)	Rare causes of thoracic aortic aneurysm.
Infectious	
Bacterial aortitis ("mycotic" aneurysm)	Usually the result of circulating bacteria seeding an abnormal aortic wall.
Syphilitic (luetic) aortitis	Aneurysms are a late consequence of the infection.
Aortic injury	
Prior acute aortic syndrome (aortic dissection, intramural hematoma, or penetrating atherosclerotic ulcer)	Sometimes the antecedent acute aortic syndrome was clinically silent or went undiagnosed.
Trauma	Aortic transsection typically results in formation of a pseudoaneurysm.

Question Which aortopathy is associated with a bifid uvula?

A. Marfan's syndrome

B. Loeys-Dietz syndrome

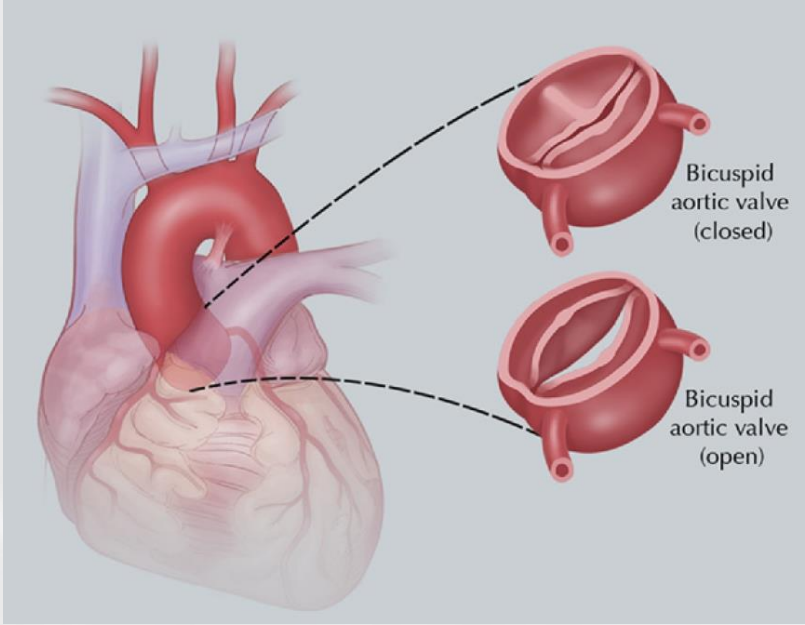
C. Turner's Syndrome

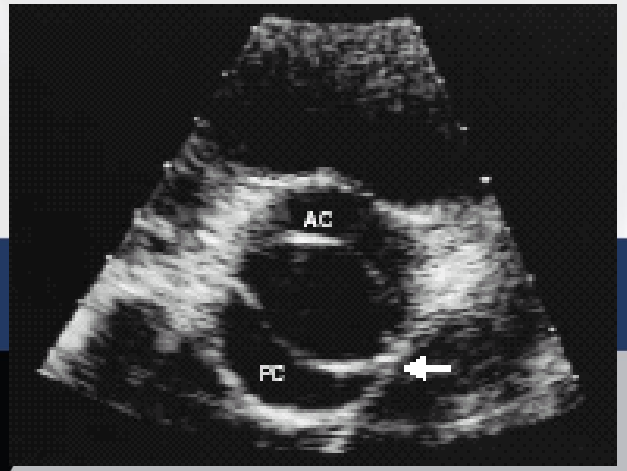
D. Bicuspid Aortopathy / Bicuspid Aortic Valve Syndrome

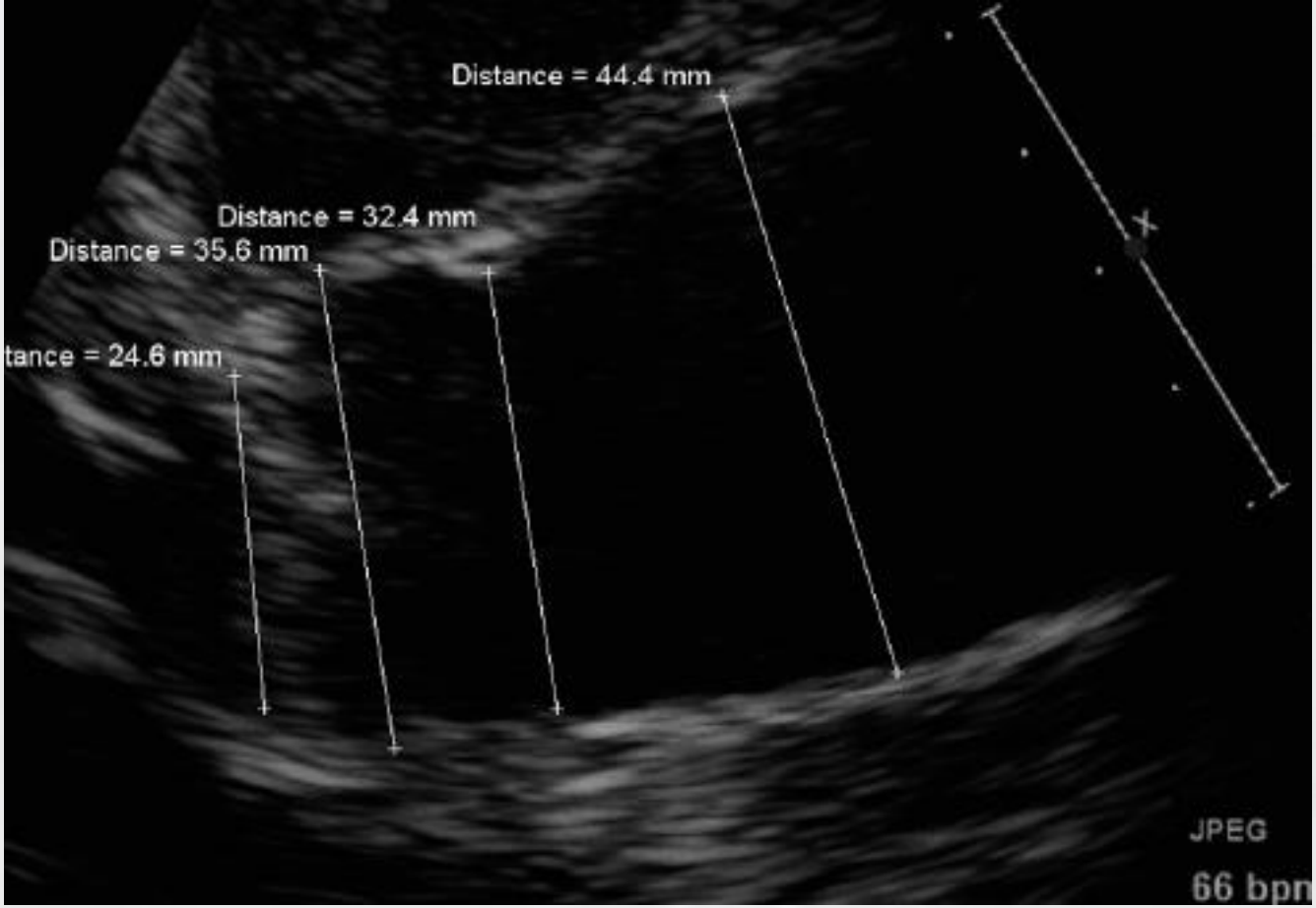
E. Haven't seen a penlight in years nor a uvula

Bicuspid Aortopathy

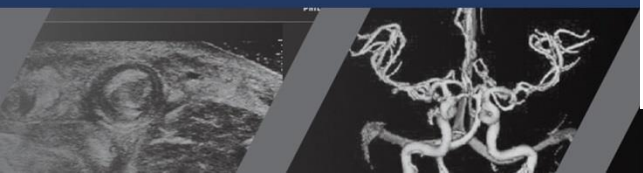
- Worldwide quantitatively the cause of most congenital cardiovascular morbidity and mortality: 15% of patients with dissection have bicuspid valves, more than Marfan's
- Can be inherited as autosomal dominant—15% family members can have aneurysms even if that family member has a normal aortic valve







AHA/ACC guidelines suggest echo screening of 1st degree relatives of those with Bicuspid Aortic valve



Biner *et al.*
Aortopathy in Families With BAV

JACC Vol. 53, No. 24, 2009
June 16, 2009:2288–95

Patient Education

- We recommend those with aortic aneurysms, even post-surgery, remain physically active, but with some restrictions.
  - Avoid any isometric exercises that might cause one to grunt (Valsalva) including weightlifting in daily living: lifting furniture, heavy suitcases, sit-ups, push-ups, pull-ups, bags of mulch, etc.
- For some this may include weight as low as 25 pounds.

Valsalva maneuver with aortic aneurysms: straining from constipation, weightlifting, chopping wood, shoveling snow: SBP can reach 300mmHG

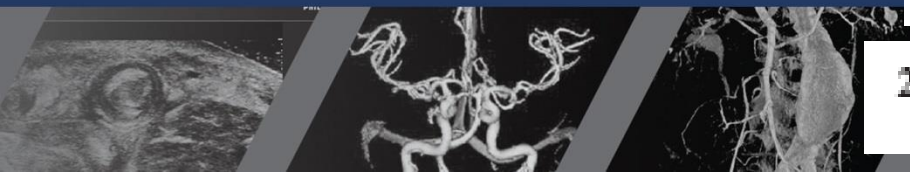
Class IIa

1. For patients with a current thoracic aortic aneurysm or dissection, or previously repaired aortic dissection, employment and lifestyle restrictions are reasonable, including the avoidance of strenuous lifting, pushing, or straining that would require a Valsalva maneuver. (*Level of Evidence: C*)

ACCF/AHA Guideline

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

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



2010 Guidelines on Thoracic Aortic Disease

Patient Education

Cardio exercise such as jogging, swimming, tennis, hiking, and cycling is recommended, up to the point of being able to maintain a conversation during exercise.

Maintain low to normal blood pressure.

Avoid blood pressure spikes:

- Decongestants, both over the counter (OTC) and prescription, containing pseudoephedrine, phenylephrine, phenylpropanolamine, and oxymetazoline. This includes Claritin D and Robitussin D
- Treat HTN with Toprol XL every 12, Bystolic, Losartan, Valsartan, Lisinopril; avoid amlodipine

USB drives

- Maintain all operative reports plus the actual CT and MRI Scan images, especially when traveling.
- These help providers in emergency situations rapidly understand the repair, prior areas of hematoma, graft locations, comparing with new scans.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ROBERT SCHUHANN

Conclusions

Recognize

- the increasing incidence of Aortic aneurysms and probably AAS as our population ages
- asymptomatic disease in high risk groups requires imaging to recognize dilation before catastrophic events occur
- All societies (STS,ACC, SVM,ATS) recommend careful measuring of the aorta perpendicular to flow (true short axis measurement)
- Careful imaging and measuring is time-consuming BUT **accurate size** is, beyond symptoms, the best intervention criterion in the 2018

Conclusions

Recognize

- Can not rely on CXR for aortic disease exclusion – neither sensitive or specific
- ‘Tortuosity’ in younger patients deserves investigation

Conclusions

Remember

- Because of frequency, Bicuspid Aortic valve is the cause of most congenital cardiovascular morbidity and mortality

- Care of patients with aortic diseases falls into a grey zone between our current specialties, emphasizing its importance.

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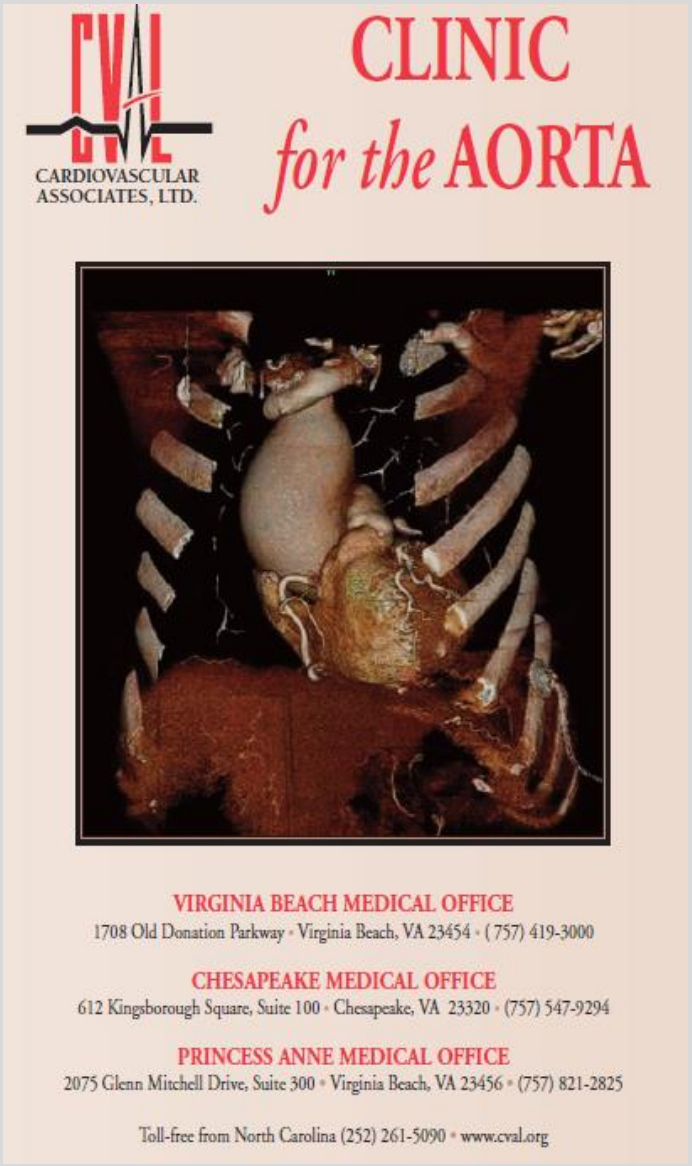

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