Diseases of the Aorta

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No disclosures

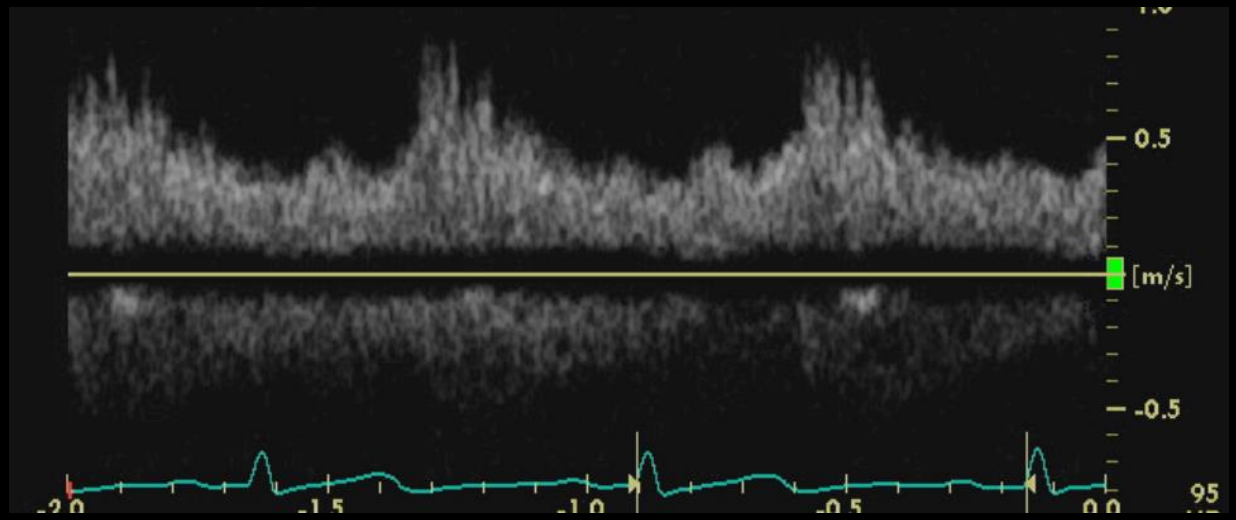
Pre-Lecture Question 1

A 69 year old woman with h/o HTN, hyperlipidemia and CAD presented to the ED with 3 days of back pain. Other than a BP of 168/96 mm Hg her physical exam was unremarkable. EKG revealed LVH and strain. CXR and TTE were normal. A TEE was performed to exclude dissection. Ascending aorta and arch were normal.

TEE shows:

1) Normal aorta
2) Intramural hematoma
3) Penetrating aortic ulcer
4) Clotted dissection

Pre-Lecture Question 2

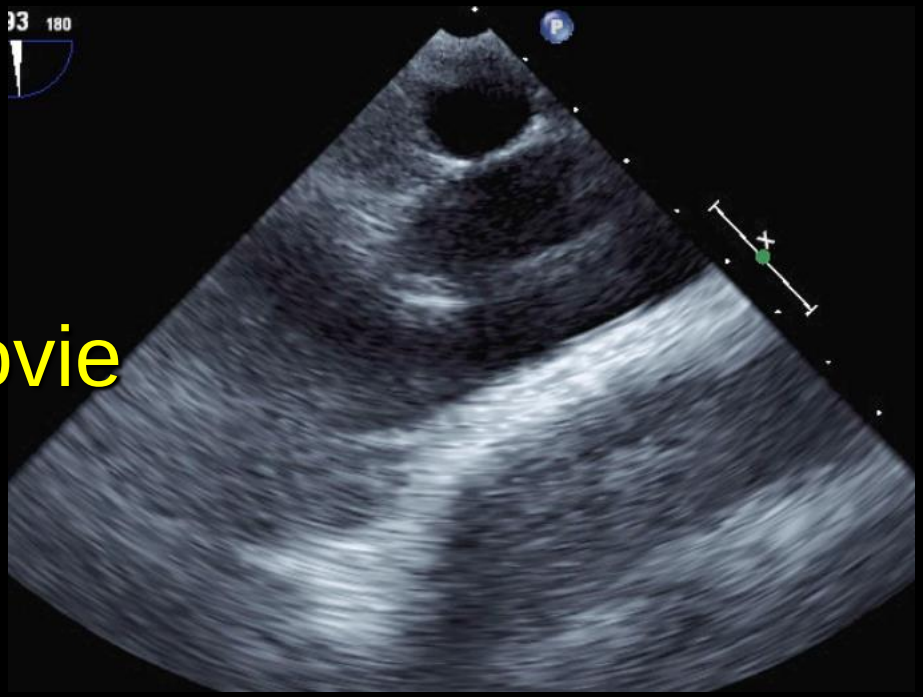


This pulsed Doppler recording of distal thoracic aorta is seen in:

1) Normal aorta
2) Intramural hematoma
3) Penetrating aortic ulcer
4) Clotted dissection

Pre-Lecture Question 2

Movie



The most likely interpretation is:

1) Artefact
2) Dissection flap
3) Linear thrombus
4) A catheter in the aorta

Aortic Dissection

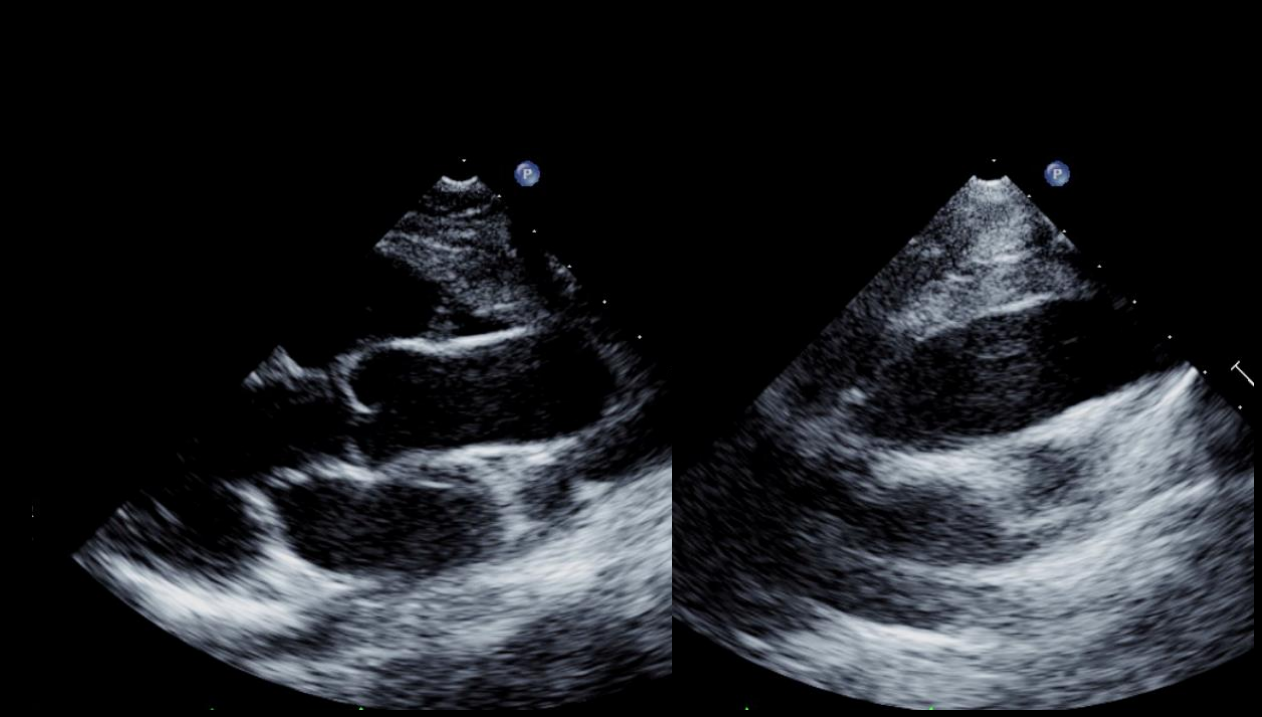
Aortic Aneurysm

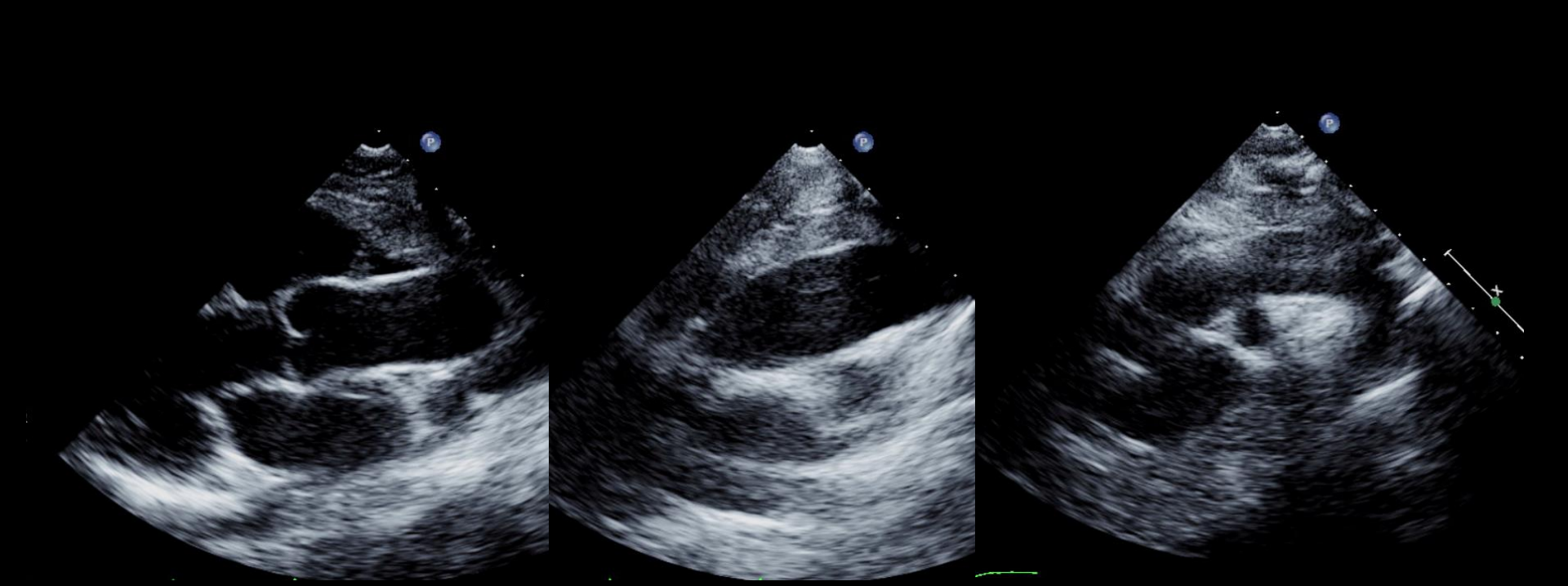
Penetrating Ulcer

Aortic Trauma

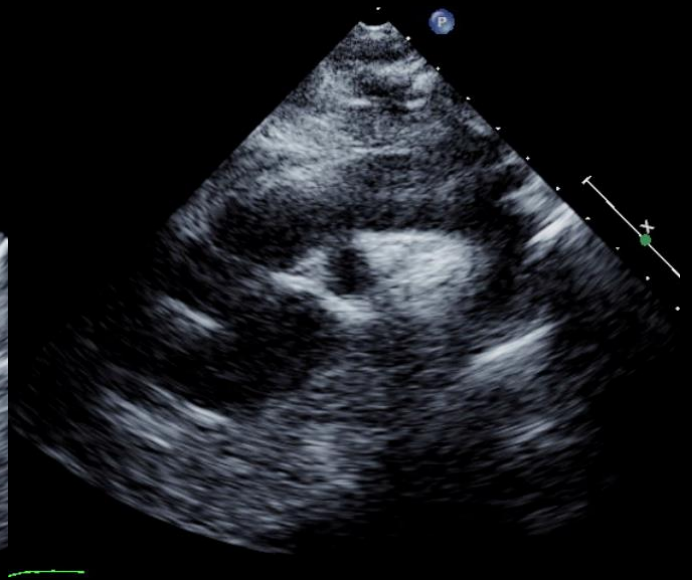
Aortic Atheroma

Imaging of the Aorta









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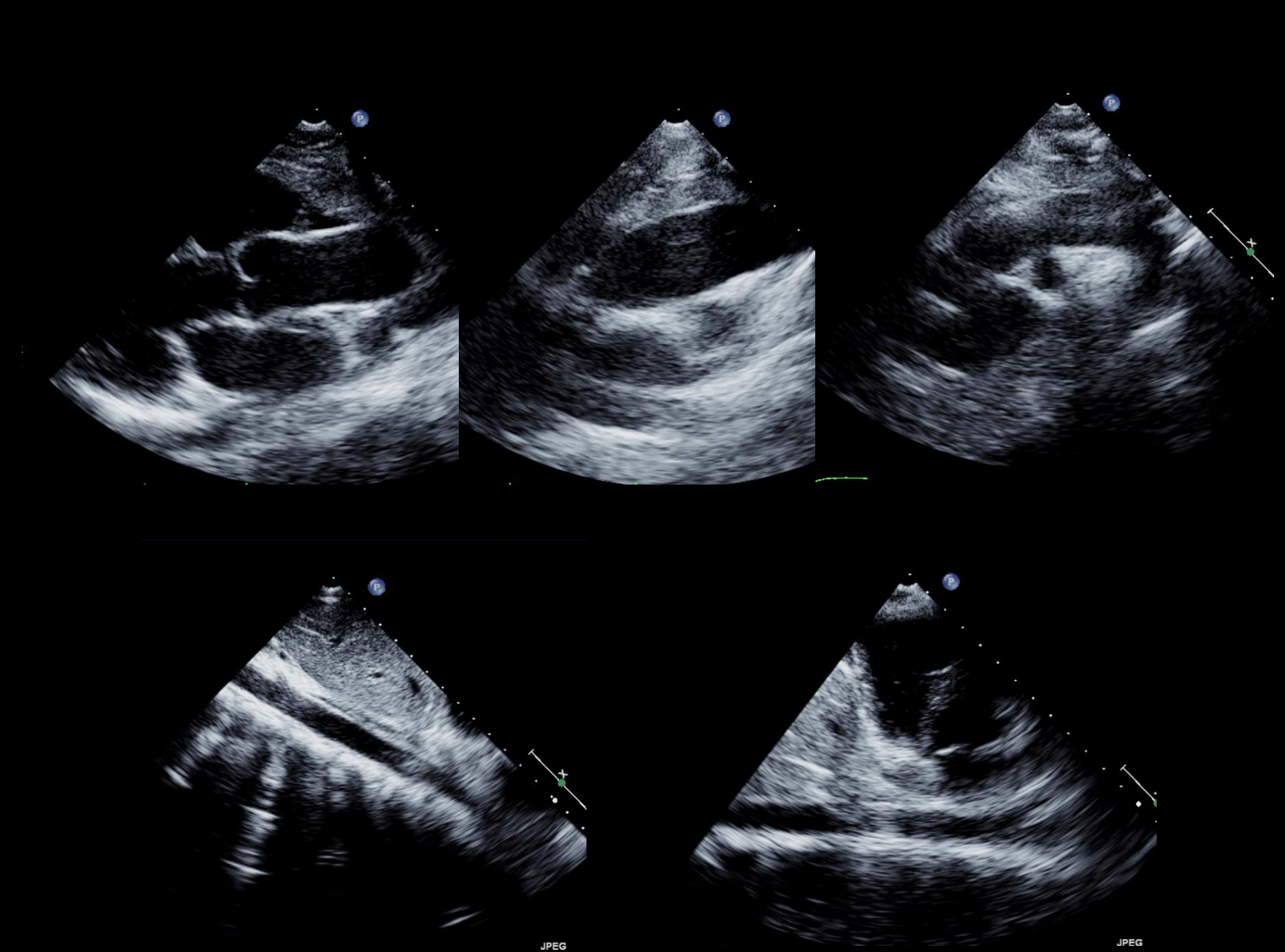
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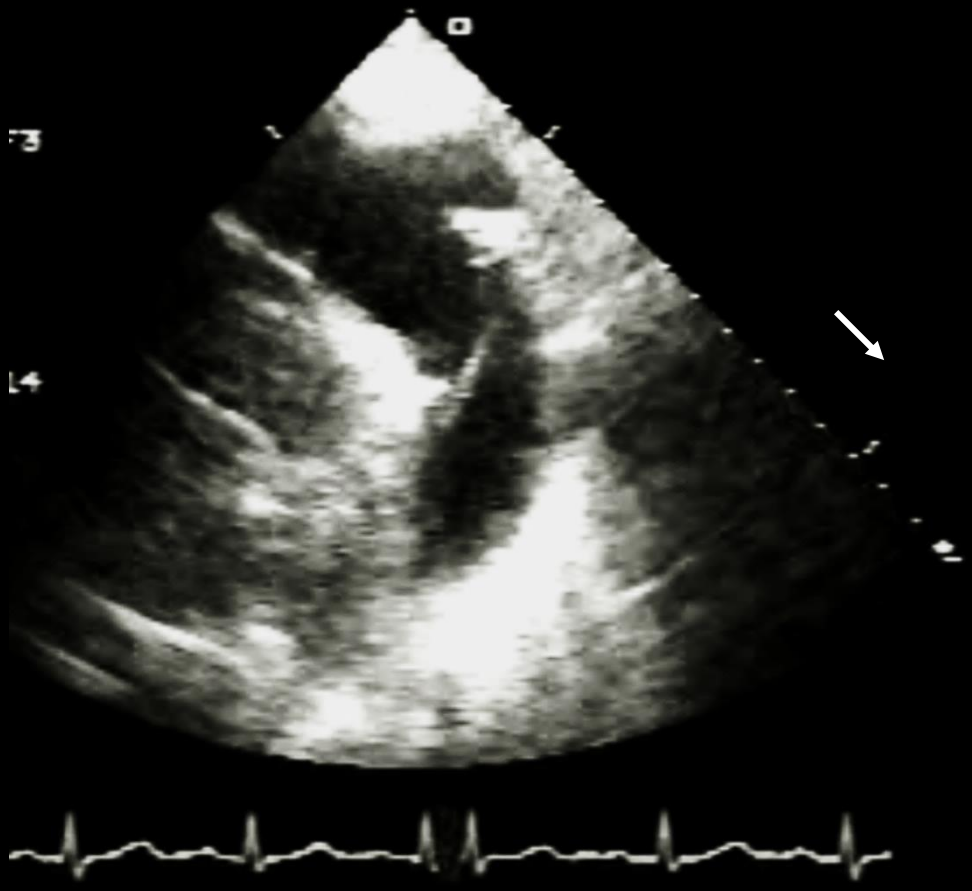
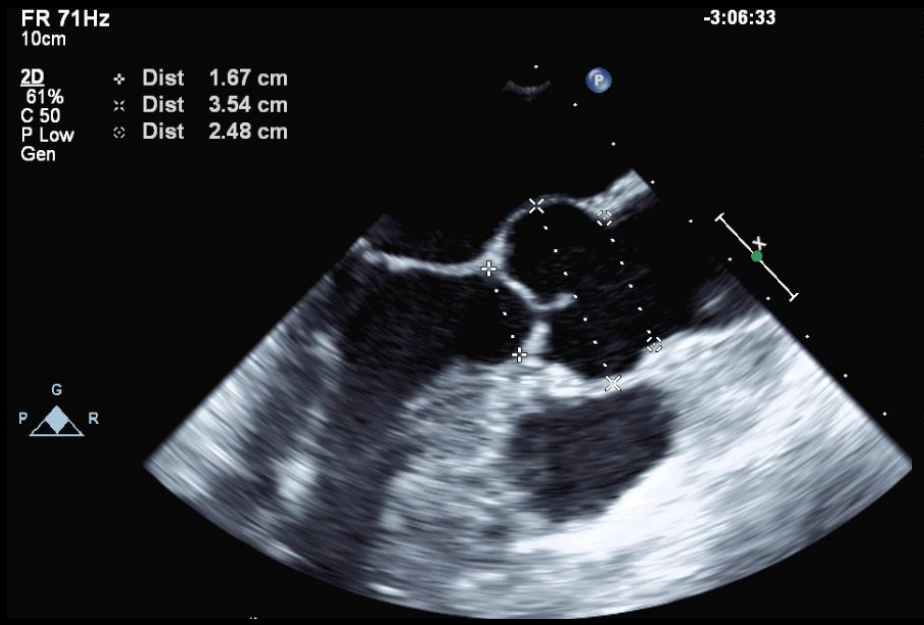


Suprasternal View


FR 71Hz
10cm
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2D
61%
C 50
P Low
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Dist 1.67 cm
Dist 3.54 cm
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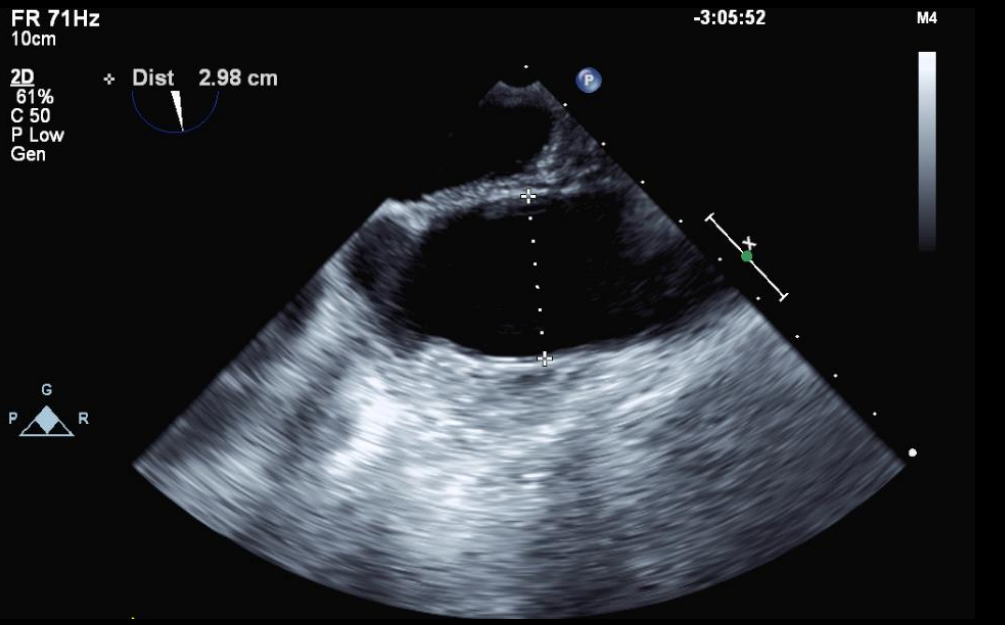
FR 71Hz
10cm
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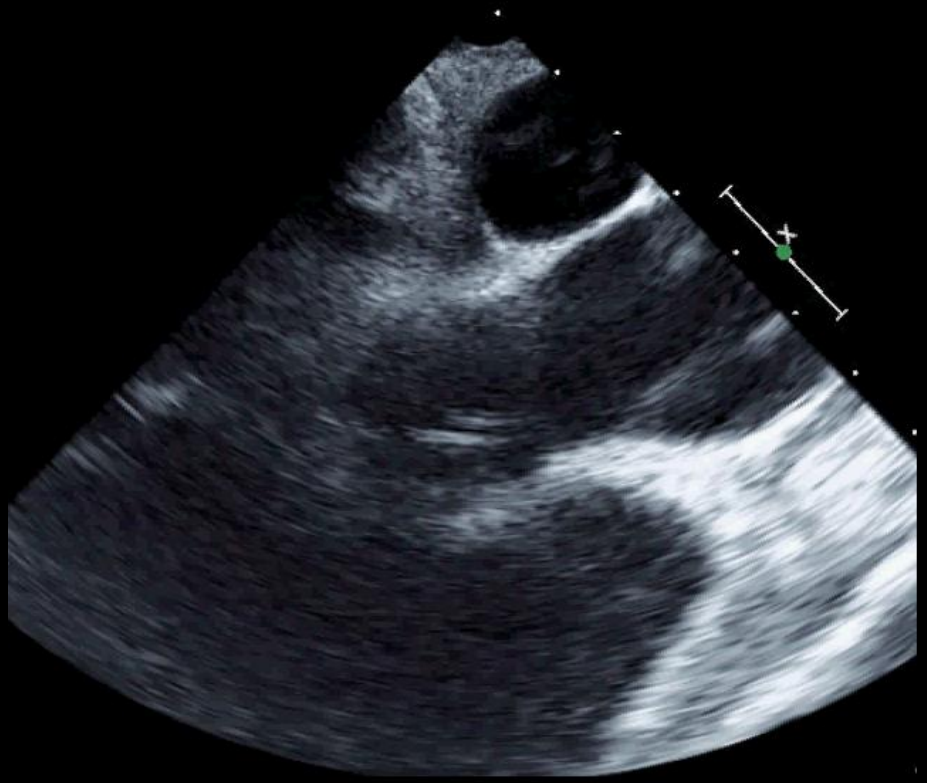
M4
2D
61%
C 50
P Low
Gen
Dist 2.98 cm
G
P
R

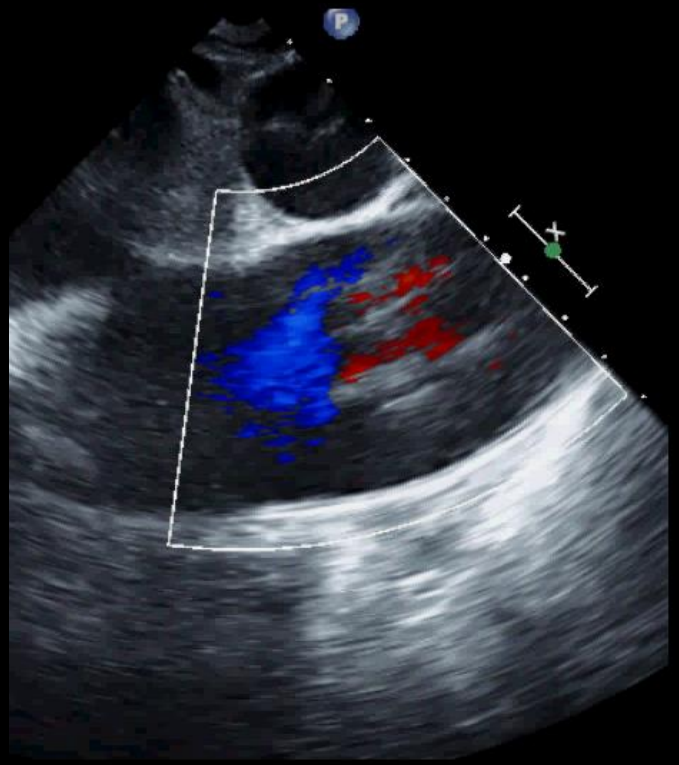
		MEN		WOMEN	
		Absolute cm	Index cm/m2	Absolute cm	Index cm/m2
Aortic annulus	Upper limit Mean+/- SD	3.1 2.6+/-0.3	1.6 1.3+/-0.1	2.6 2.3+/-O.2	1.6 1.3+/-0.1
Sinus of Valsalva	Upper limit Mean+/- SD	4 3.4+/-0.3	2.1 1.7+/-0.2	3.6 3.0+/-0.3	2.1 1.8+/-0.2
Supra-aortic ridge	Upper limit Mean+/- SD	3.6 2.9+/-0.3	1.9 1.5+/-0.2	3.2 2.6+/-0.3	1.9 1.5+/-0.2
Prox Asc Ao	Upper limit Mean+/- SD	3.7-3.8 3.0+/-0.4	 1.5+/-0.2	3.7-3.8 2.7+/-0.4	 1.6+/-0.3

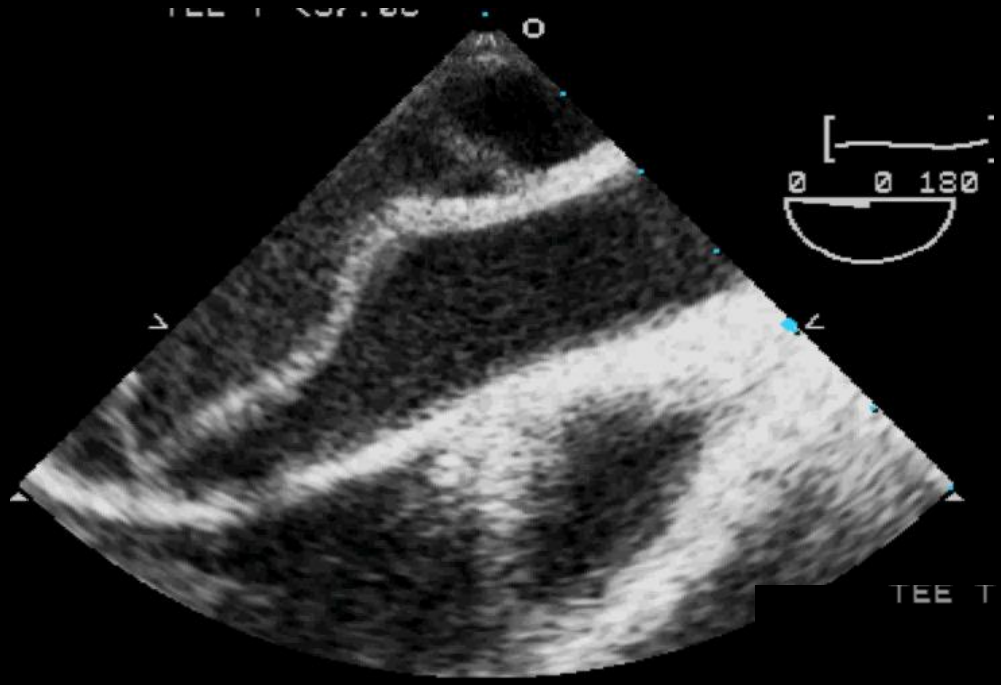
Roman MJ et al Am J Cardiol 1989; 64:507-512; and Erbel R et al. European Heart Journal 2001; 22: 1542-1681

Case

? Aortic Dissection



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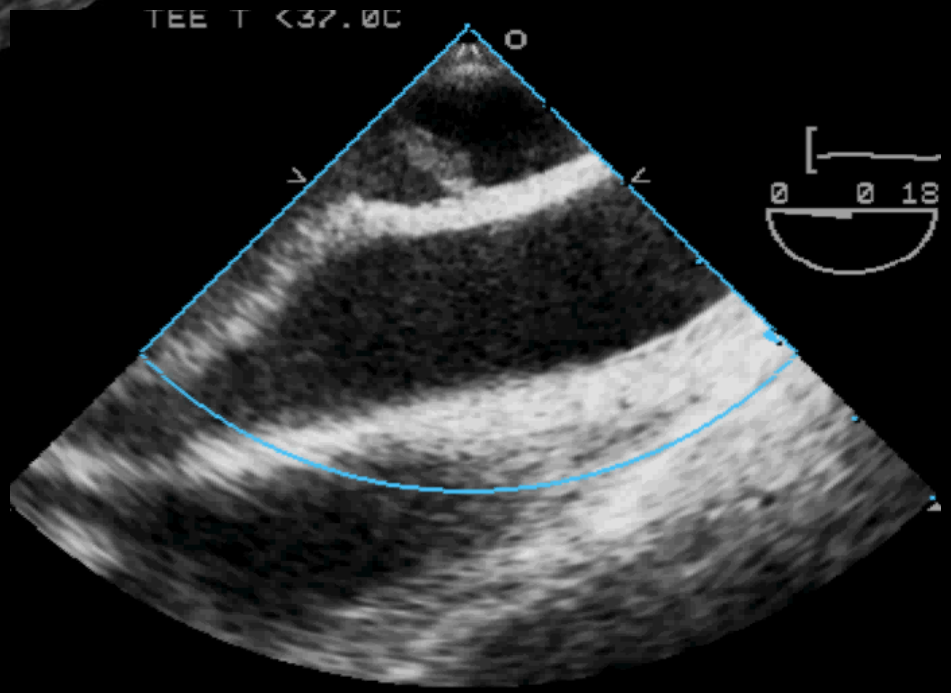
TEE T <37.0C
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Case

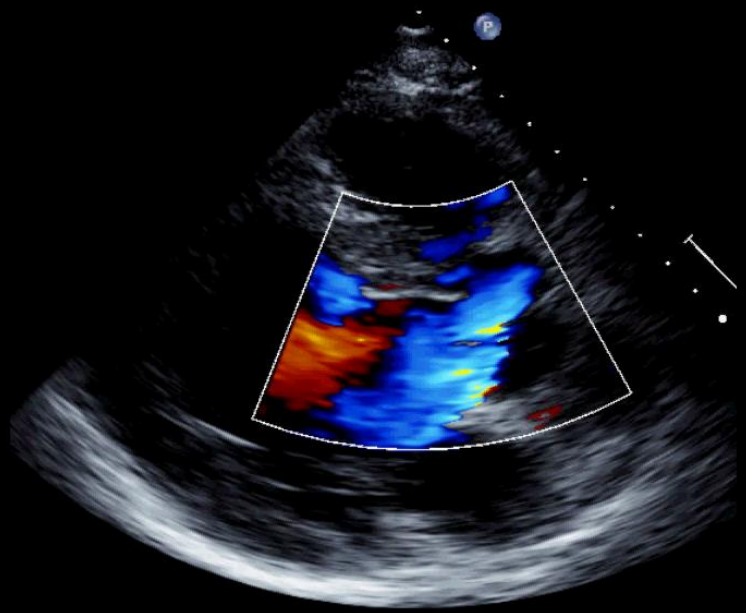

LGC
OFF

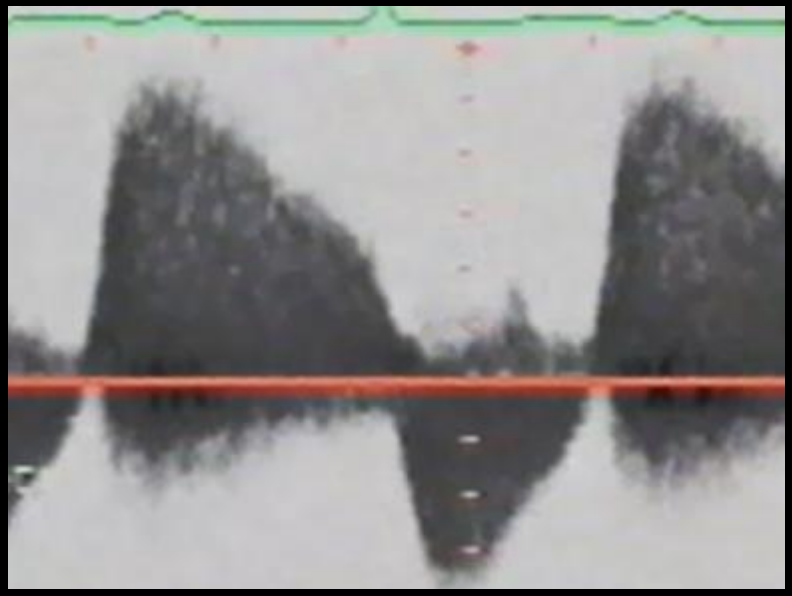
?

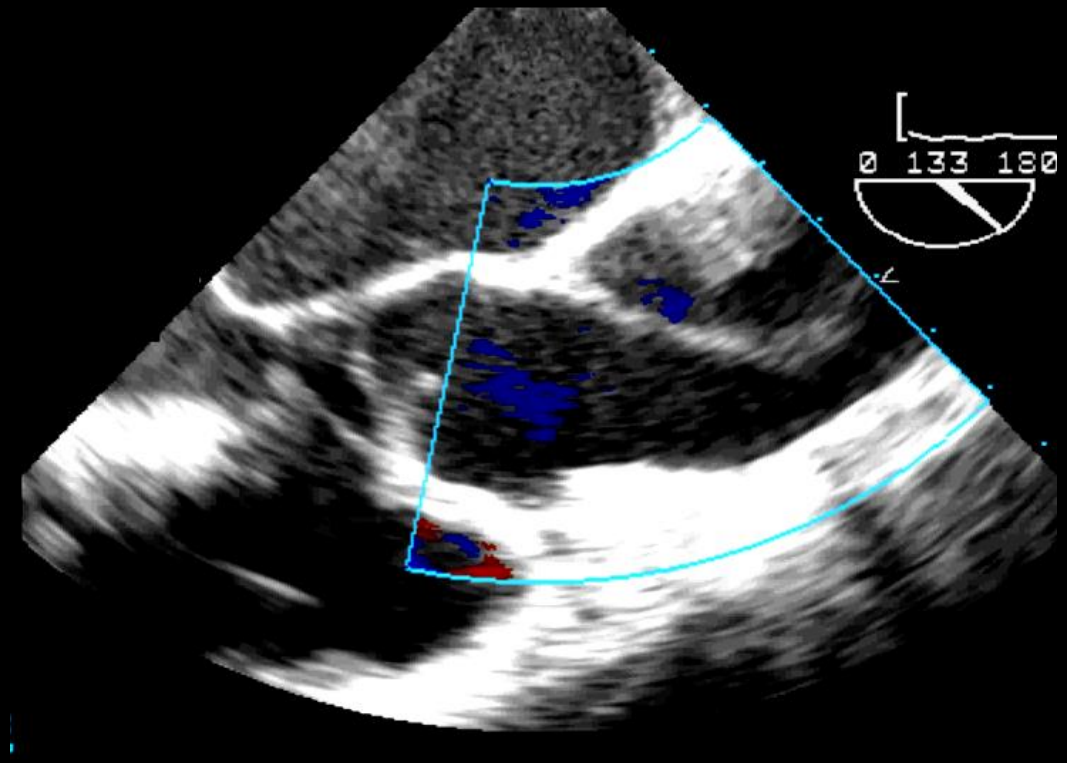

LGC OFF


TEE T: 99.6°F
LGC OFF

Case



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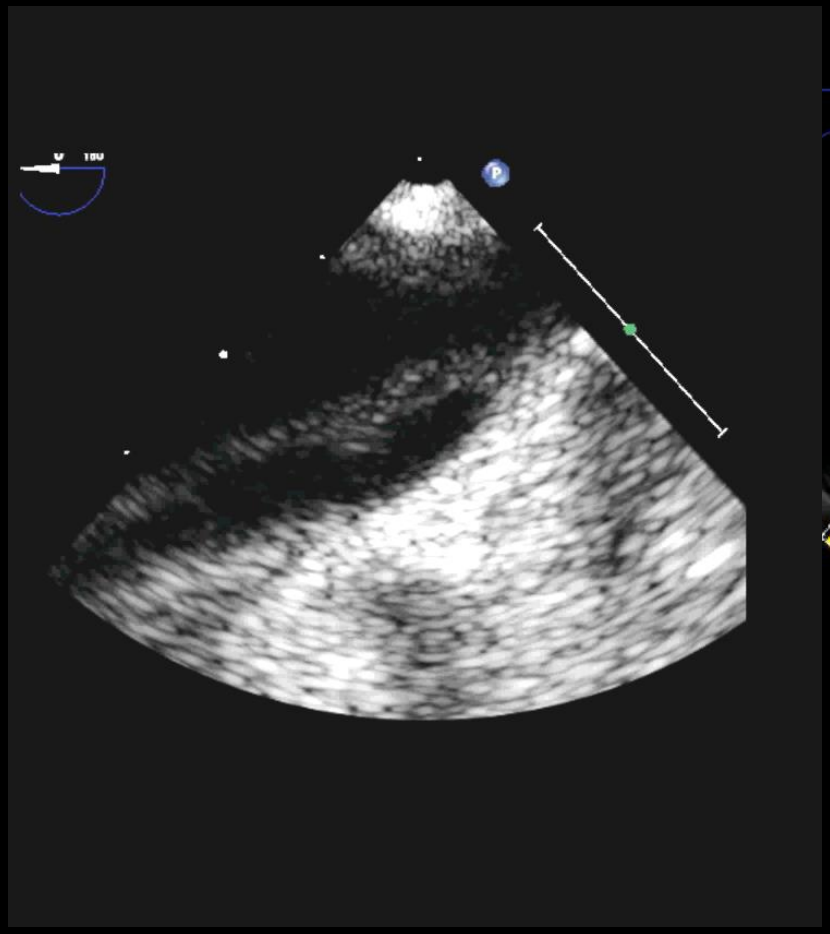

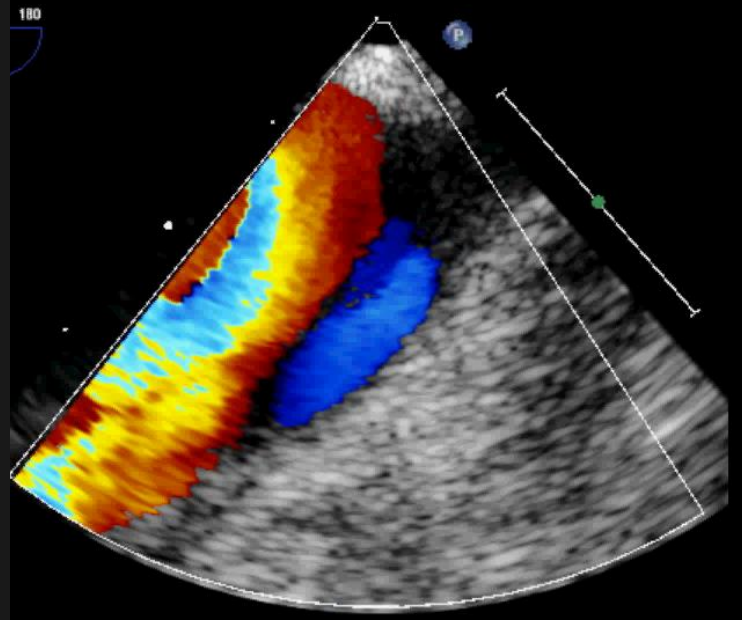
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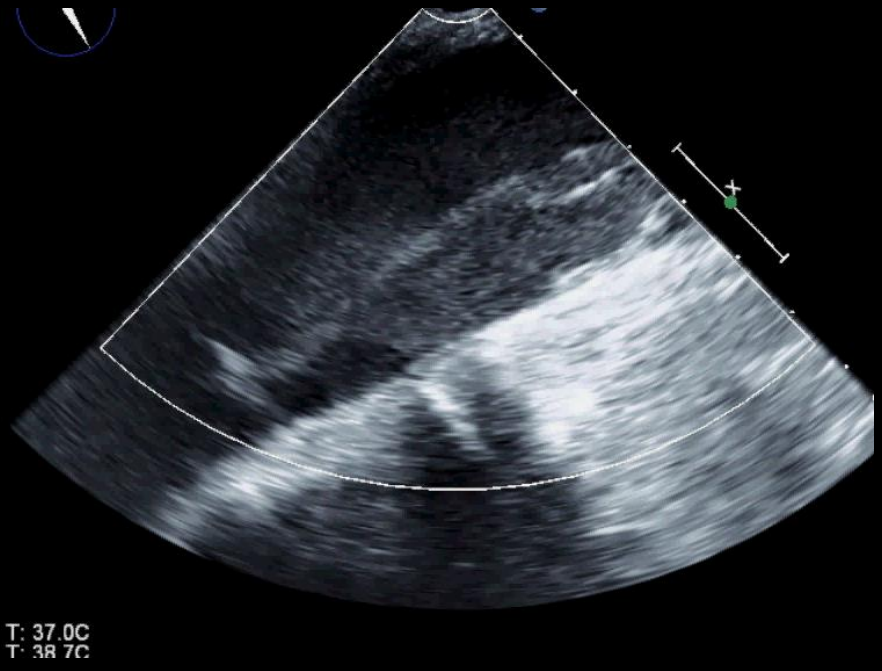
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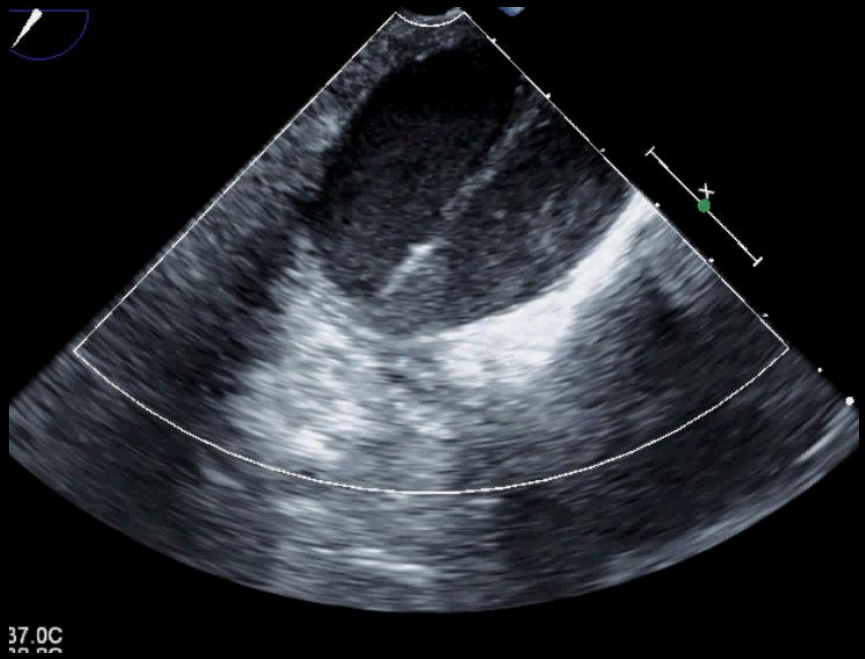
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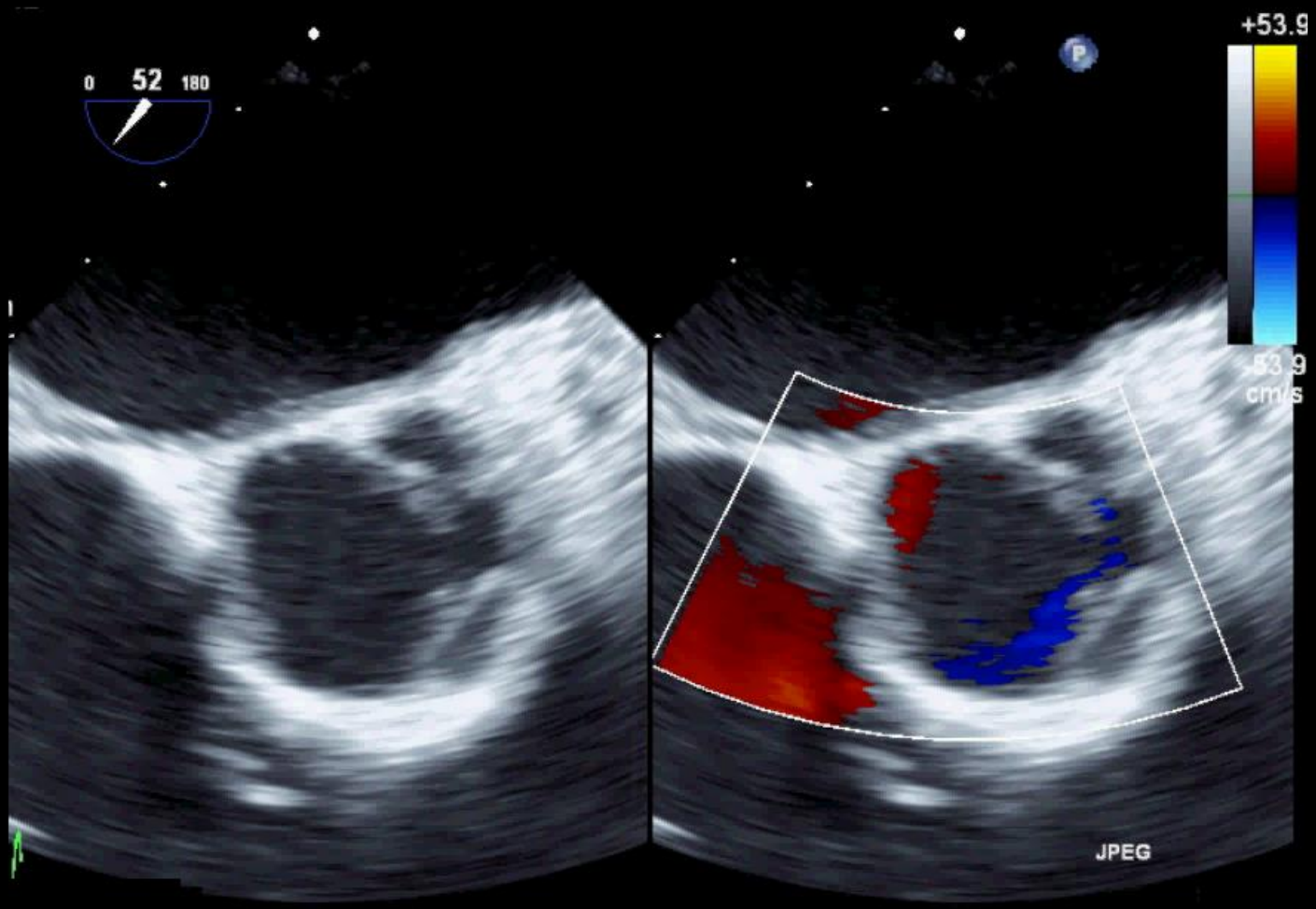
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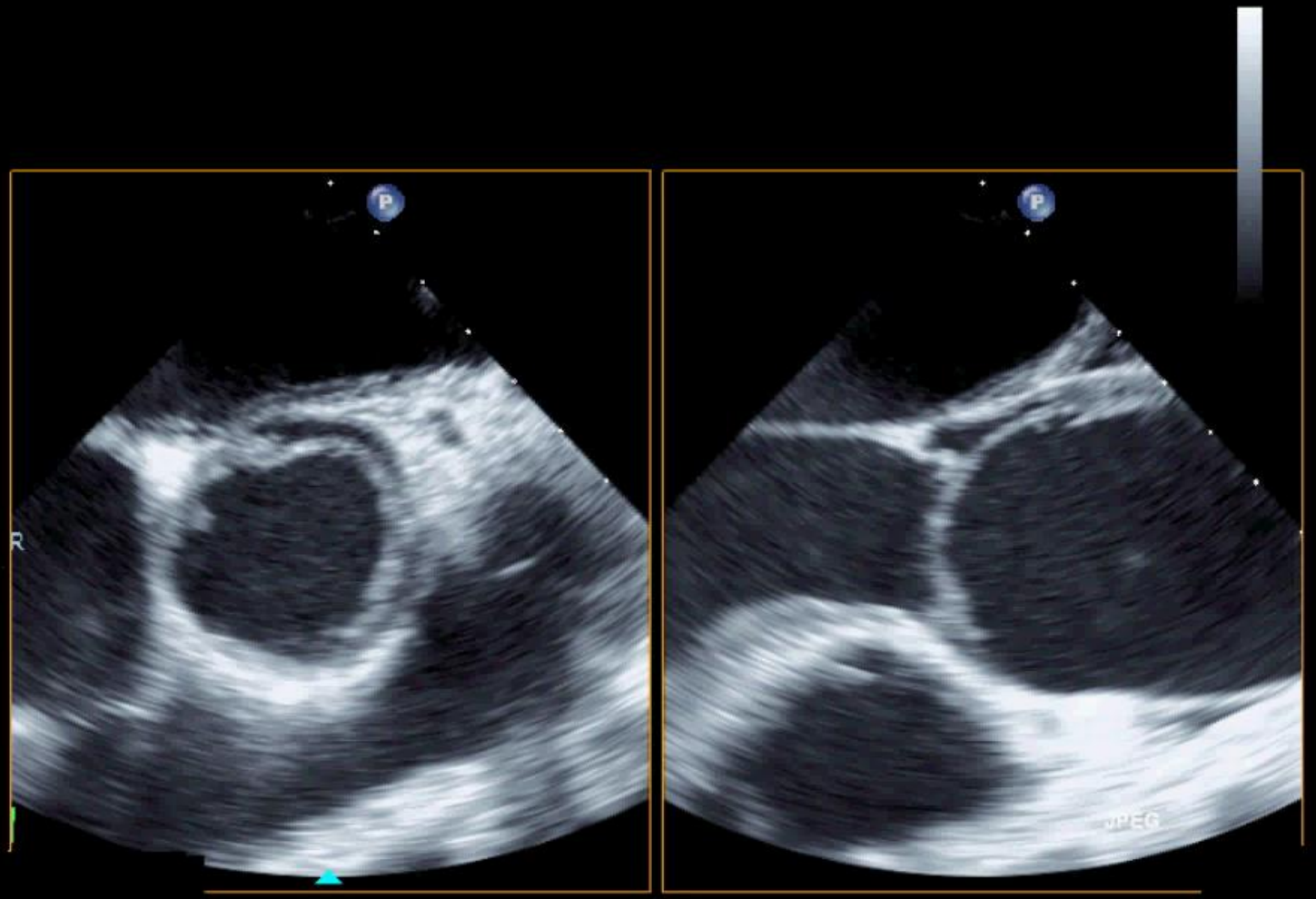
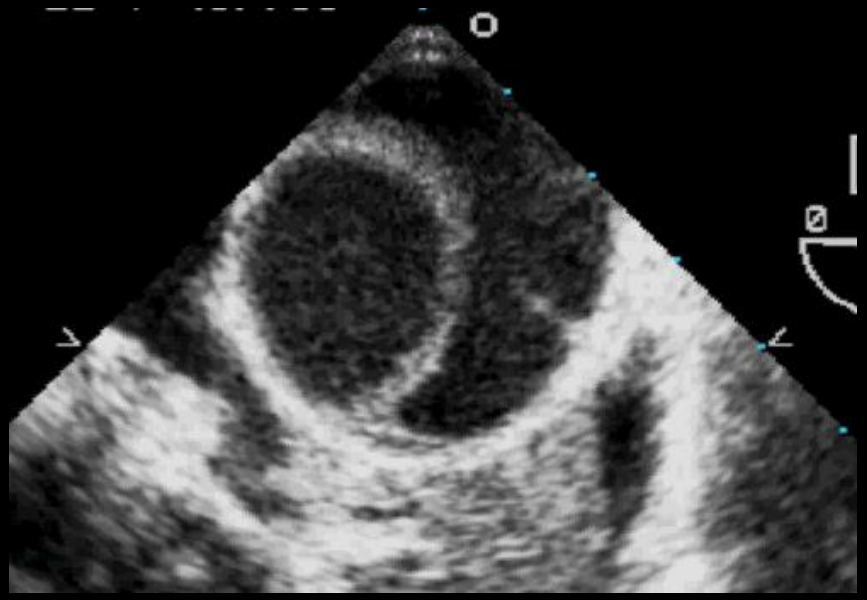
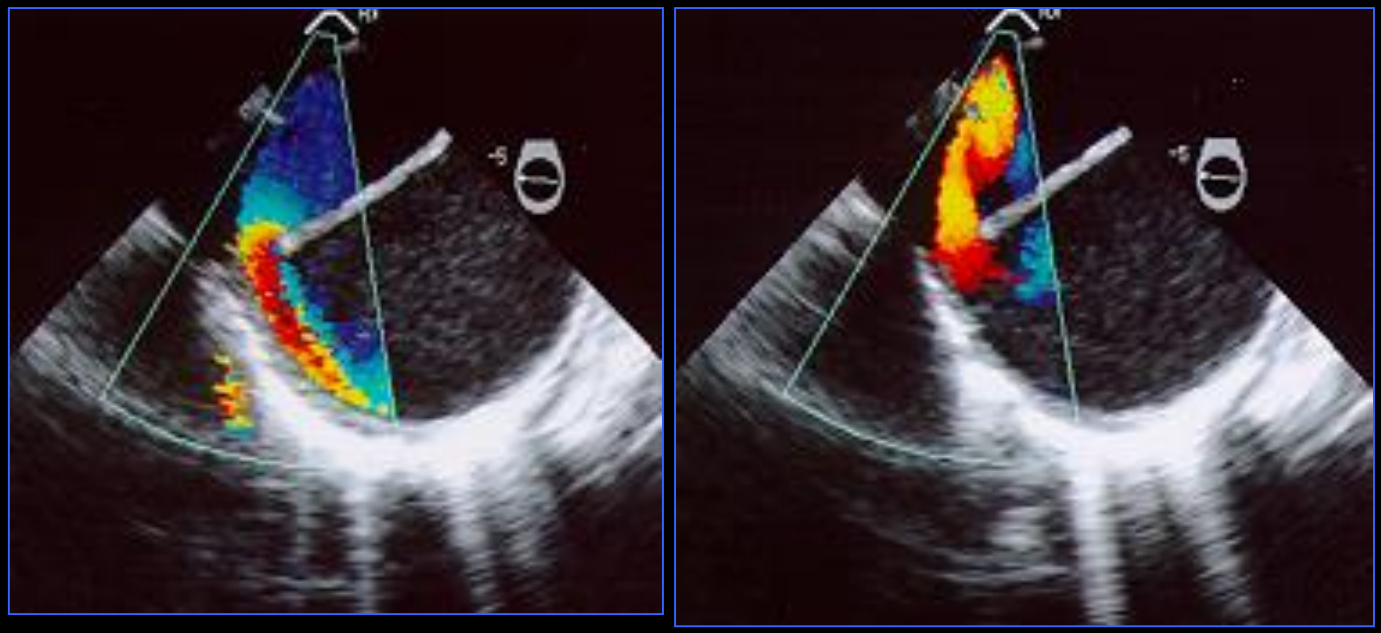






Aortic Dissection

If

If aortic dissection is not diagnosed and treated promptly

If aortic dissection is not diagnosed and treated promptly

The mortality escalates every hr

Aortic Dissection
Mortality Rates

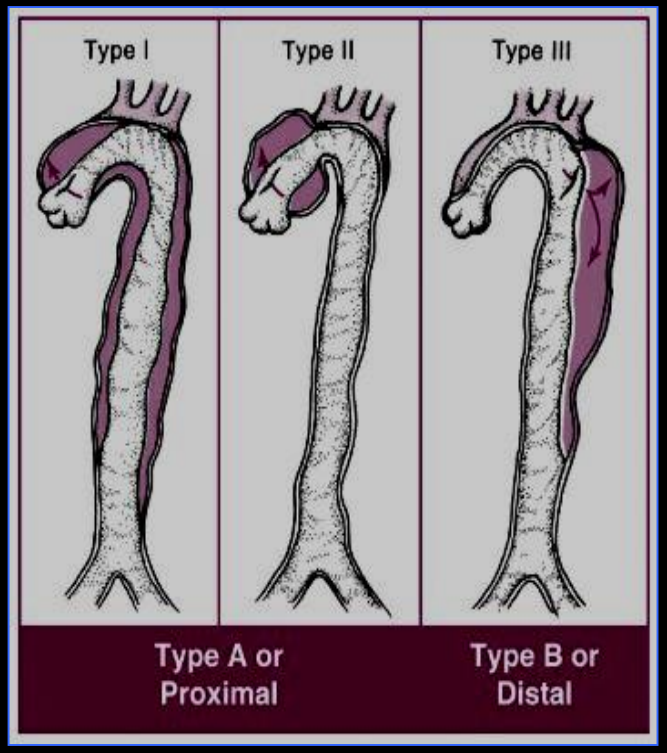
21% within 24 hrs

49% at four days

74% at two weeks

93% at one year

Aortic Dissection



Acute Aortic Dissection

- 2000 new cases reported in US per year
- True incidence possibly 10,000 per year

Clinical History

- Sudden severe pain: 74-90% cases
- May propagate or be localized
- 90% with antr pain only: Asc. Aorta
- 90% with intrascap pain: Desc. aorta
- Other symptoms:
  - Branches compromised
  - Rupture/Leakage

Aortic Dissection

Transthoracic Echo

Acoustic window not optimal in all pts.

Sensitivity: 59 - 85%

Specificity: 63 - 96%

Aortic Dissection
TEE

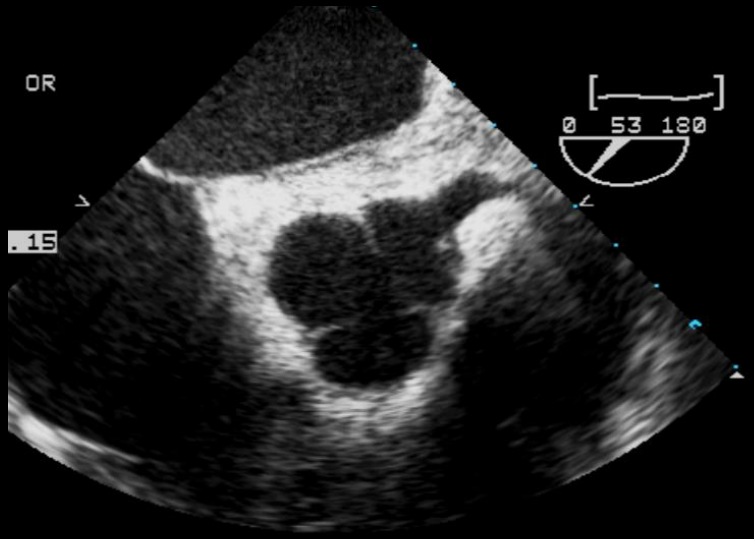
Investigator	Pts	Sen %	Sp %
Erbel ‘89	164	99	98
Nienabar ‘93	110	94	87*
Keren ‘96	112	100	100
Sommer ‘96	49	96	96

Aortic Dissection

“All I need to know is the diagnosis and location”

TEE in Aortic Dissection

- Intimal flap, True/False lumen
- Entry sites, Prox extent, Type
- Patency or clot in false lumen
- Aortic regurgitation
- Coronary involvement
- LV wall motion, LV function
- Pericardial effusion
- Aortic ring sizing for surgery
- Assessment of surgery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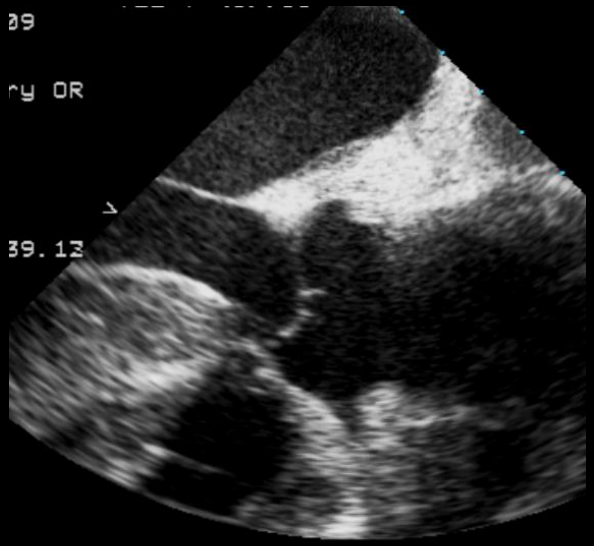
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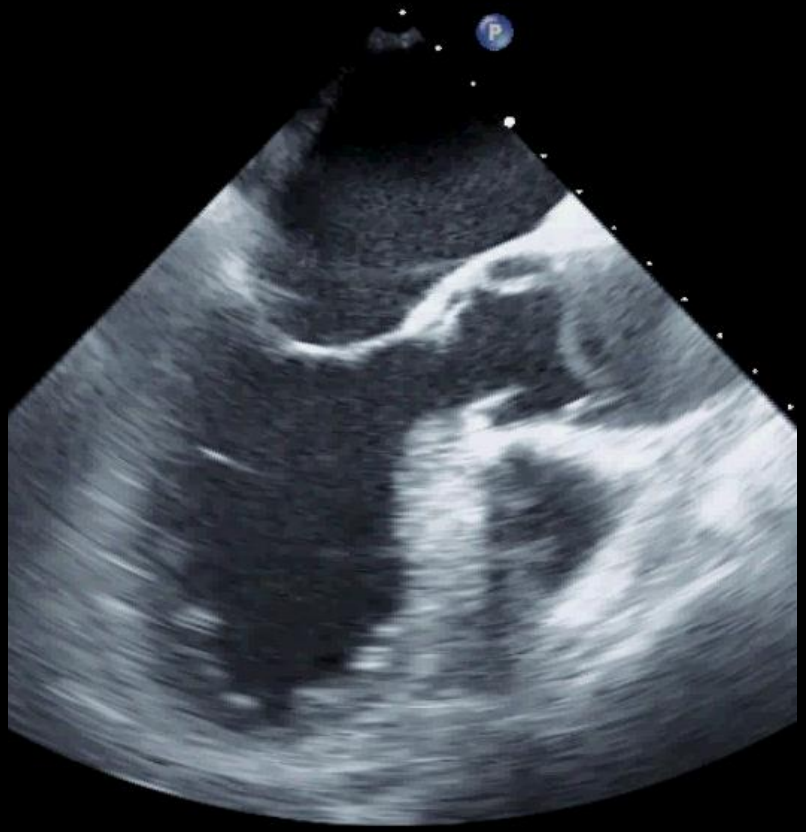
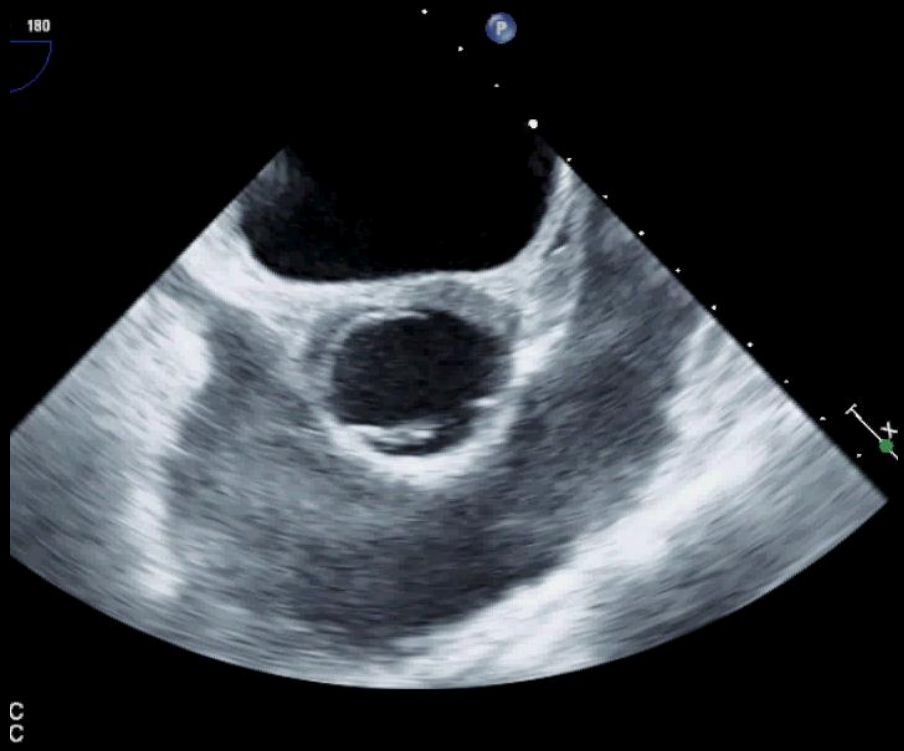
Case

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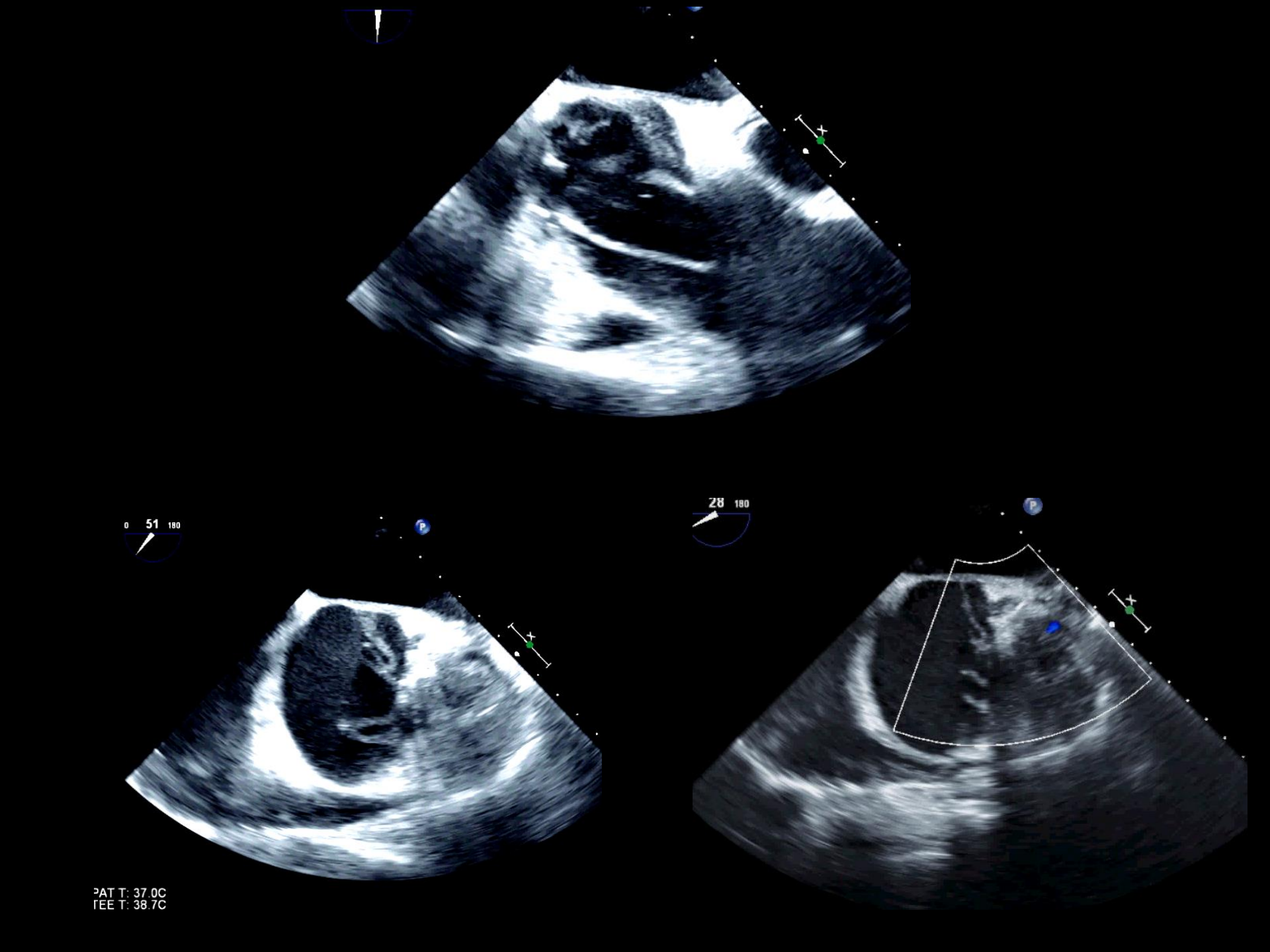
Case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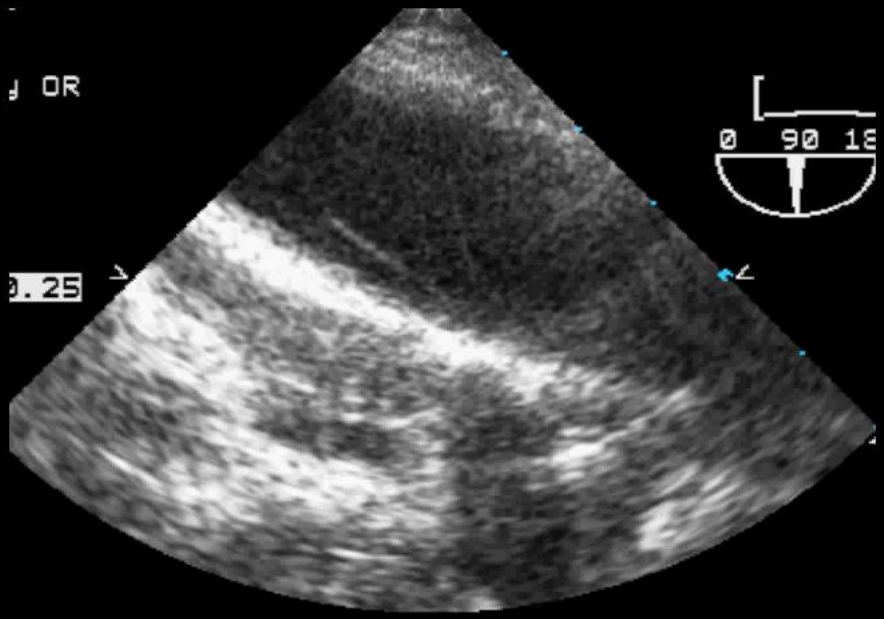
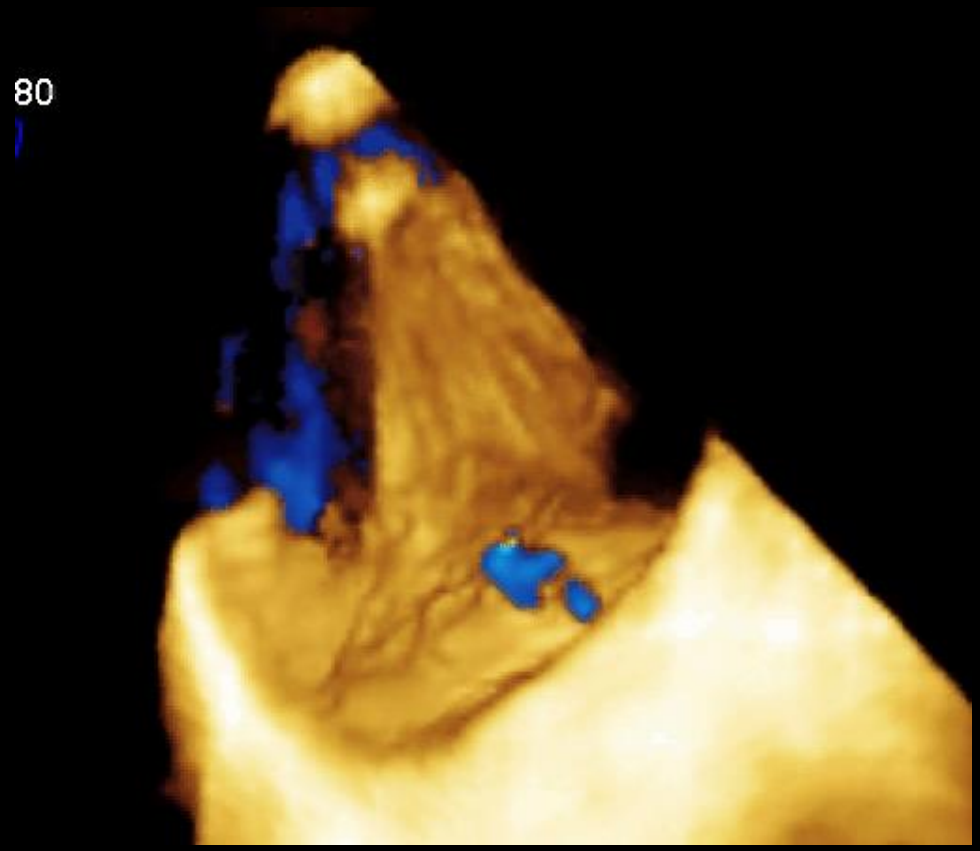
PAT T: 37.0C
TEE T: 38.7C

Case

Cor Angio: Normal coronaries
Back pain in the cath lab

Cor Angio: Normal coronaries
Back pain in the cath lab

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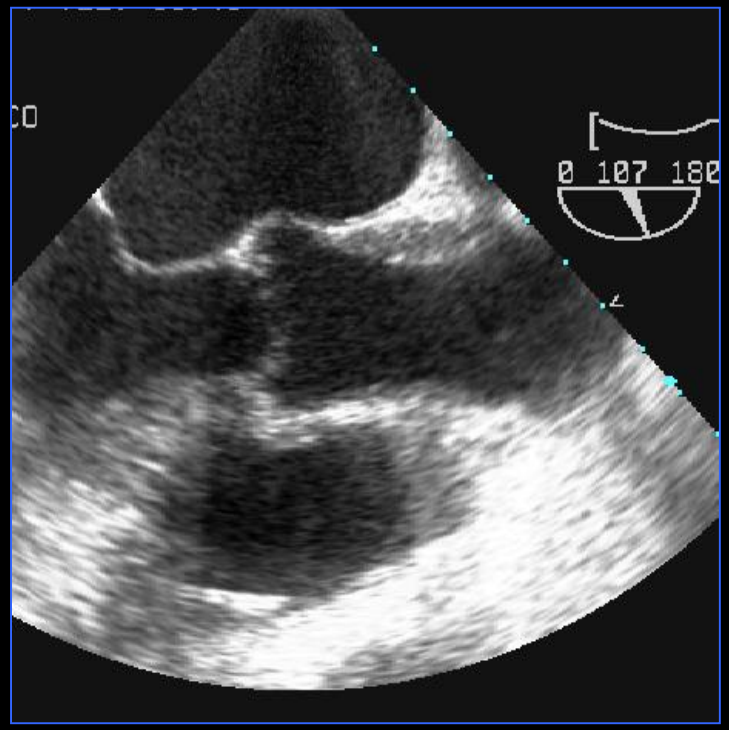


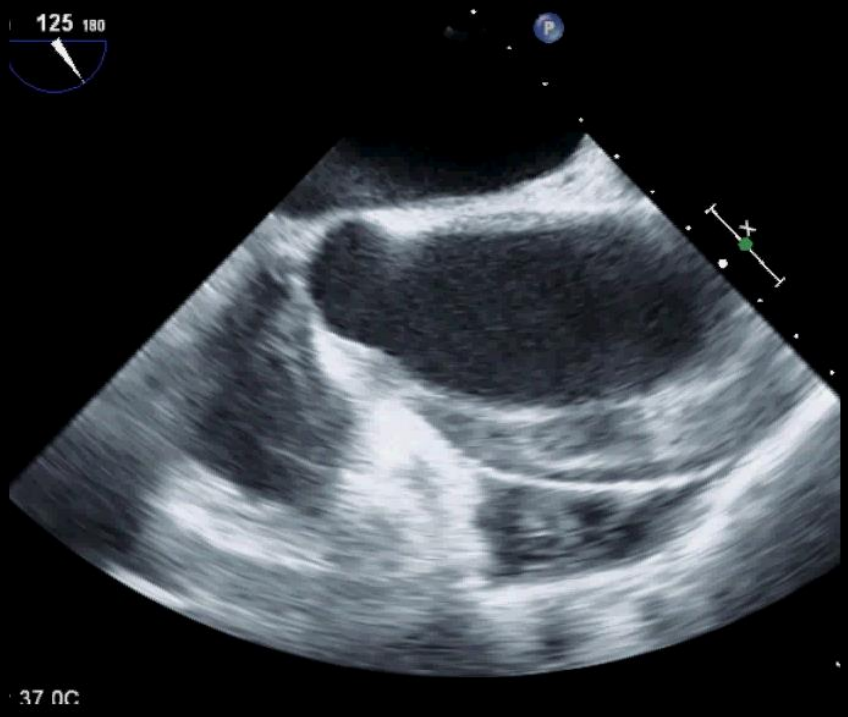
Aortic Dissection

Yes

No

Not sure

Case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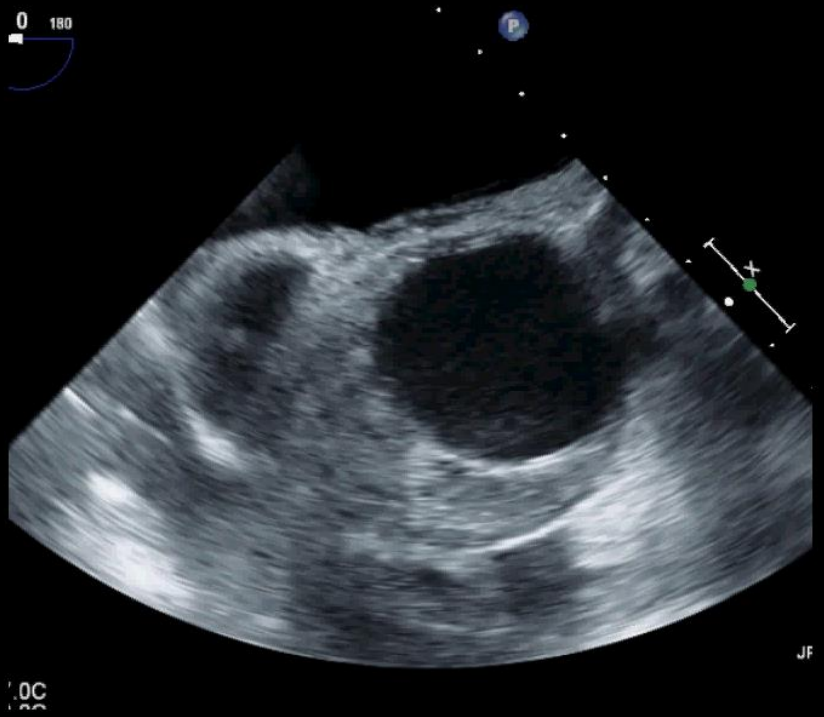
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Intramural Hematoma

About 6 - 20% of aortic dissection are intramural hematoma cases

(106/553 from pooled data)

Intramural Hematoma

- Thickening of aortic wall (>0.7 cm) with central displacement of intimal layer
- Displaced intimal calcium
- Absence of flap/fenestration
- May be echolucent but no flow
- Increased external aortic diameter

Intramural Hematoma

Acute Intramural Hematoma of the Aorta

A Mystery in Evolution

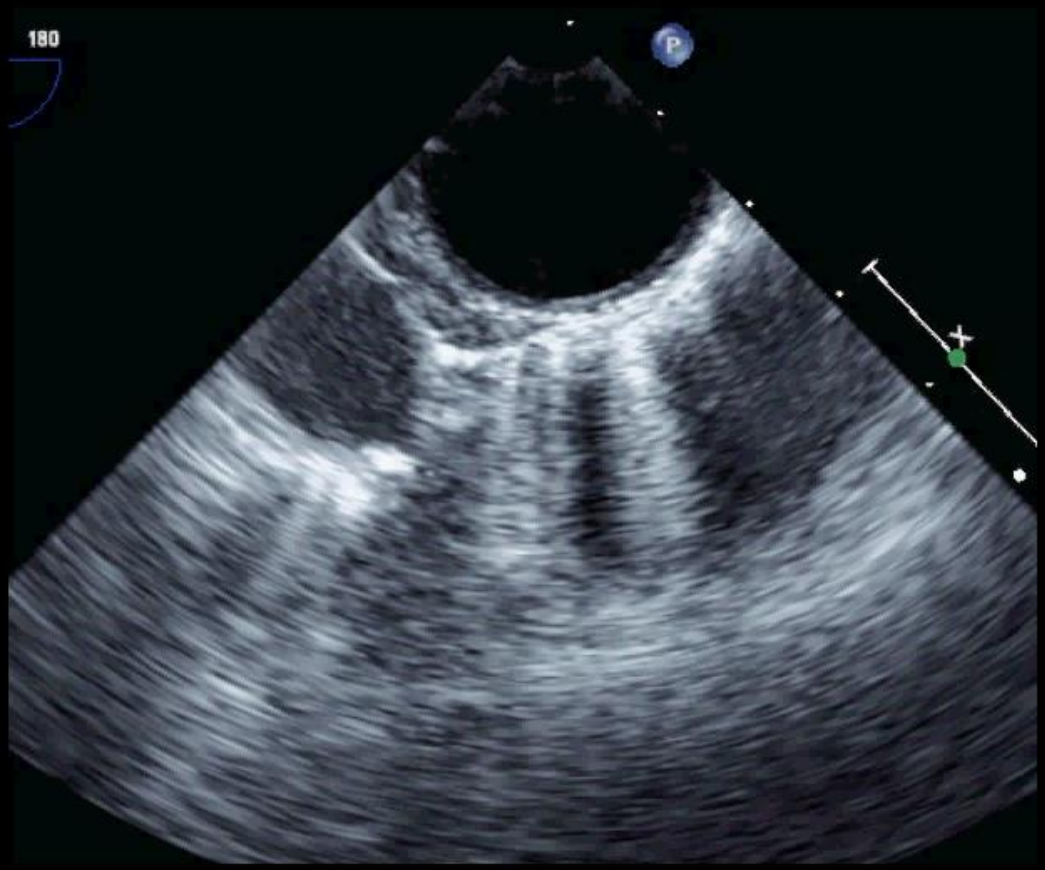
Arturo Evangelista, MD; Debabrata Mukherjee, MD; Rajendra H. Mehta, MD; Patrick T. O'Gara, MD; Rossella Fattori, MD; Jeanna V. Cooper, MS; Dean E. Smith, PhD; Jae K. Oh, MD; Stuart Hutchison, MD; Udo Sechtem, MD; Eric M. Isselbacher, MD; Christoph A. Nienaber, MD; Linda A. Pape, MD; Kim A. Eagle, MD; for the International Registry of Aortic Dissection (IRAD) Investigators*

Background—The definition, prevalence, outcomes, and appropriate treatment strategies for acute intramural hematoma (IMH) continue to be debated.

Methods and Results—We studied 1010 patients with acute aortic syndromes who were enrolled in the International Registry of Aortic Dissection (IRAD) to delineate the prevalence, presentation, management, and outcomes of acute IMH by comparing these patients with those with classic aortic dissection (AD). Fifty-eight (5.7%) patients had IMH, and this cohort tended to be older (68.7 versus 61.7 years; $P<0.001$) and more likely to have distal aortic involvement (60.3% versus 35.3%; $P<0.001$) compared with 952 patients with AD. Patients with IMH described more severe initial pain than did those with AD but were less likely to have ischemic leg pain, pulse deficits, or aortic valve insufficiency; moreover, they required a longer time to diagnosis and more diagnostic tests. Overall mortality of IMH was similar to that of classic AD (20.7% versus 23.9%; $P=0.57$), as was mortality in patients with IMH of the descending aorta (8.3%

Treat like dissection

Conclusions—The IRAD data demonstrate a 5.7% prevalence of IMH in patients with acute aortic syndromes. Like classic AD, IMH is a highly lethal condition when it involves the ascending aorta and surgical therapy should be considered, but this condition is less critical when limited to the arch or descending aorta. Fully 16% of patients have evidence of evolution to dissection on serial imaging. (*Circulation*. **2005;111:1063-1070.**)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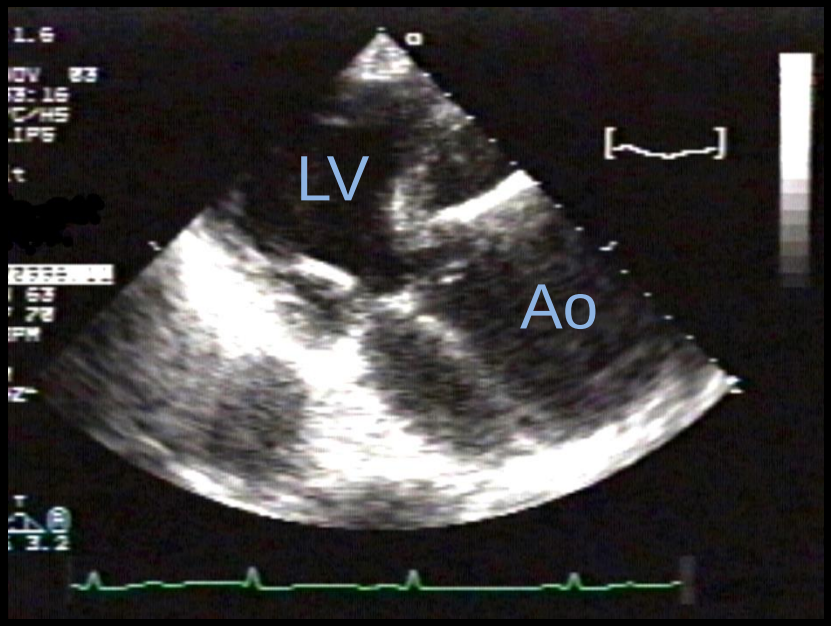
Diagnosis of Intramural Hematoma

	Intramural Hematoma	Atheroma Plaque
Intralum surface	Usually smooth	Usually irregular
Echodensity	Hypoechoic	Hyperechoic
Involvement	Usually localized	Usually diffuse
Peric effusion	May be present	--

Aortic Dissection
Follow-Up

- Upto 29% of late deaths after surgery due to rupture of dissecting aneurysm or dissection at remote site
- Incidence of subsequent aneurysm at remote site is 17 - 25%
- In the majority, subsequent dissection develops within 2 years


LV
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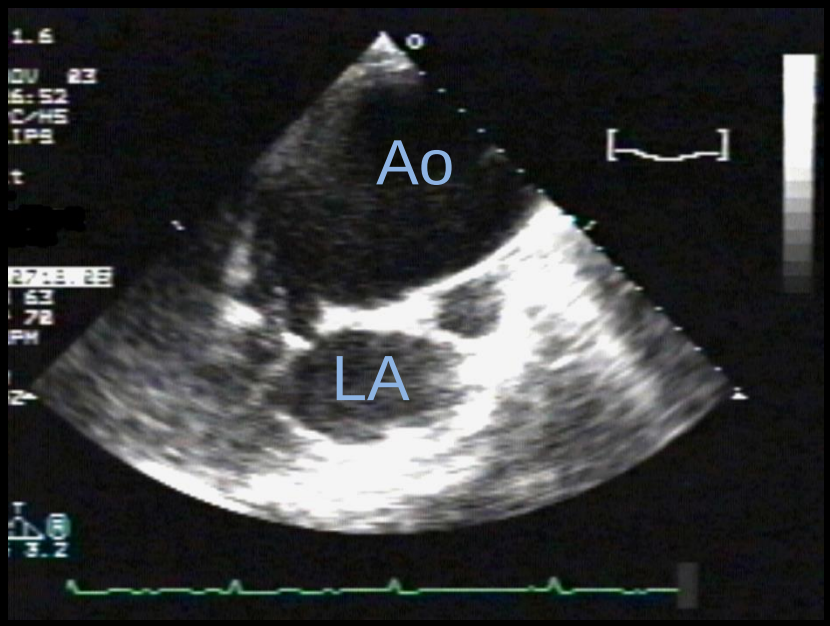
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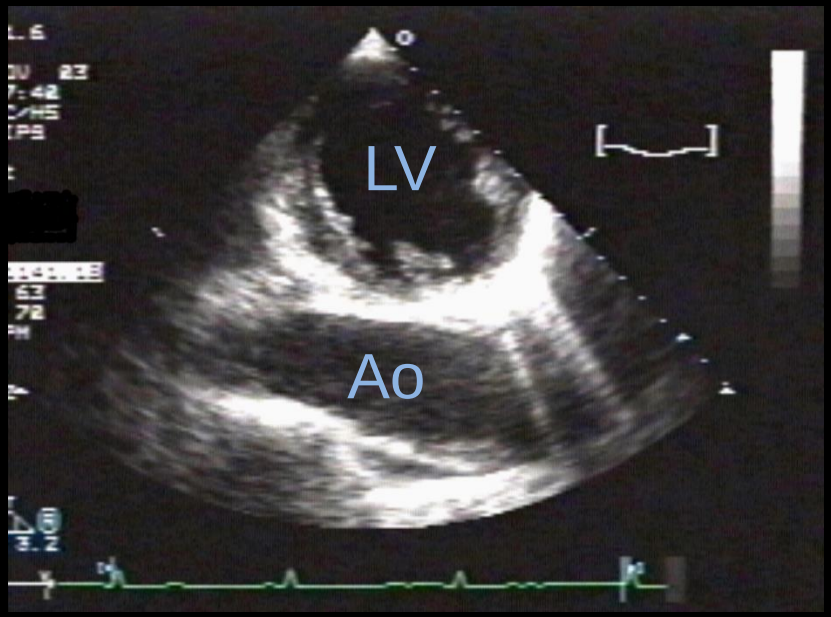
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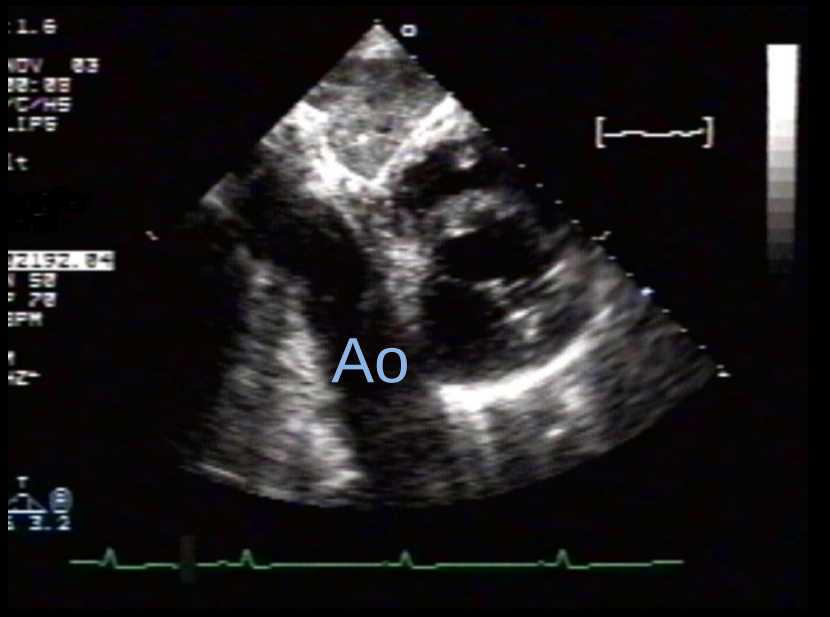

Ao

Aortic Aneurysm

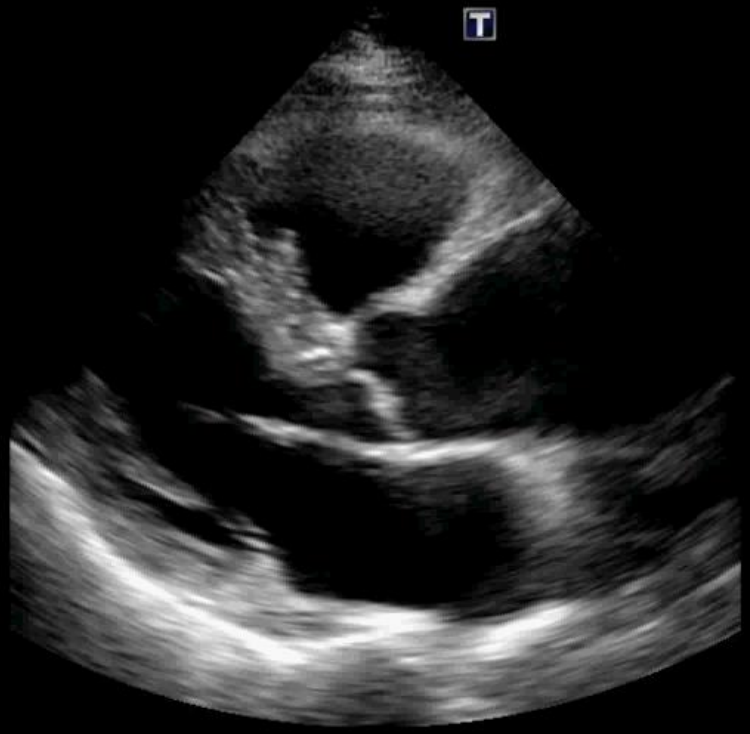
Types of aortic aneurysms

SACCULAR
Unilateral pouchlike bulge with a narrow neck

FUSIFORM
A spindle-shaped bulge encompassing the entire diameter of the vessel

DISSECTING
A hemorrhagic separation of the medial layer of the vessel wall, which creates a false lumen

FALSE ANEURYSM
A pulsating hematoma resulting from trauma and often mistaken for an abdominal aneurysm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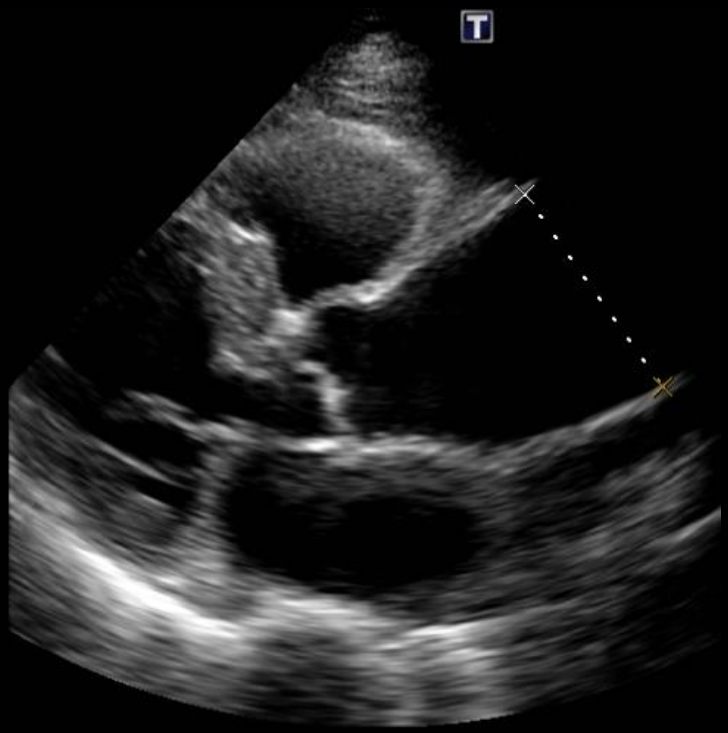
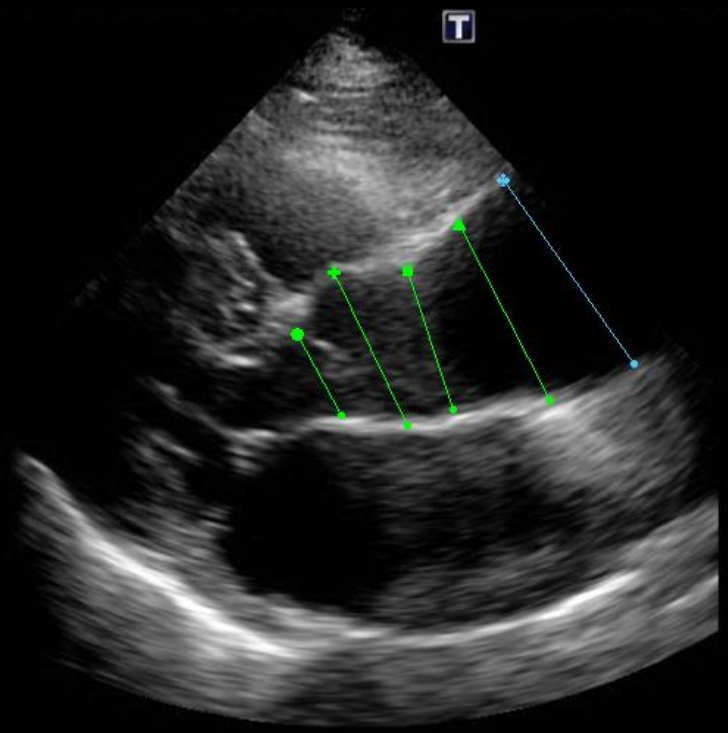
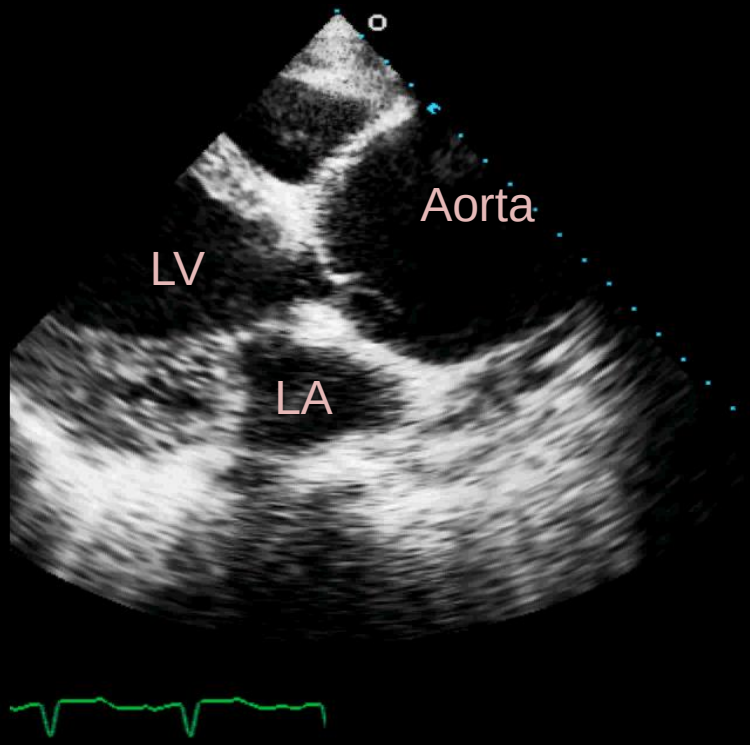




Case

Bicuspid Aortic Valve

Aortic Root Enlargement



Aortic Surgery in Dilated Aorta

AHA/ACC/ESC Guidelines

What diameter ?

Aortic Surgery in Dilated Aorta

AHA/ACC/ESC Guidelines

What diameter ?

$\geq$ 55 mm

Aortic Surgery in Pts with BAV

AHA/ACC Guidelines

Surgery to repair the aortic root or replace the ascending aorta is indicated in patients with bicuspid aortic valves if the diameter of the aortic root or ascending aorta is > 5.0 cm* or if the rate of increase in diameter is 0.5 cm/yr or more

(Level of Evidence: C)

In patients with bicuspid valves undergoing AVR because of severe AS or AR, repair of the aortic root or replacement of the ascending aorta is indicated if the diameter of the aortic root or ascending aorta is greater than 4.5 cm

(Level of Evidence: C)

CLASS I

Operative intervention to repair the aortic sinuses or replace the ascending aorta is indicated in patients with a bicuspid aortic valve if the diameter of the aortic sinuses or ascending aorta is > 5.5 cm

Level of evidence: B

CLASS IIa

Operative intervention to repair the aortic sinuses or replace the ascending aorta is reasonable in patients with bicuspid aortic valves if the diameter of the aortic sinuses or ascending aorta is greater than 5.0 cm and a risk factor for dissection is present (family history of aortic dissection or if the rate of increase in diameter is ≥ 0.5 cm per year).

Level of evidence: C

CLASS IIa

Replacement of the ascending aorta is reasonable in patients with a bicuspid aortic valve who are undergoing aortic valve surgery because of severe AS/AR if the ascending aorta diameter is > 4.5 cm.
Level of evidence: C

Replacement of the sinuses of Valsalva is not necessary in all cases and should be individualized

Disorders associated with Aortic Aneurysms

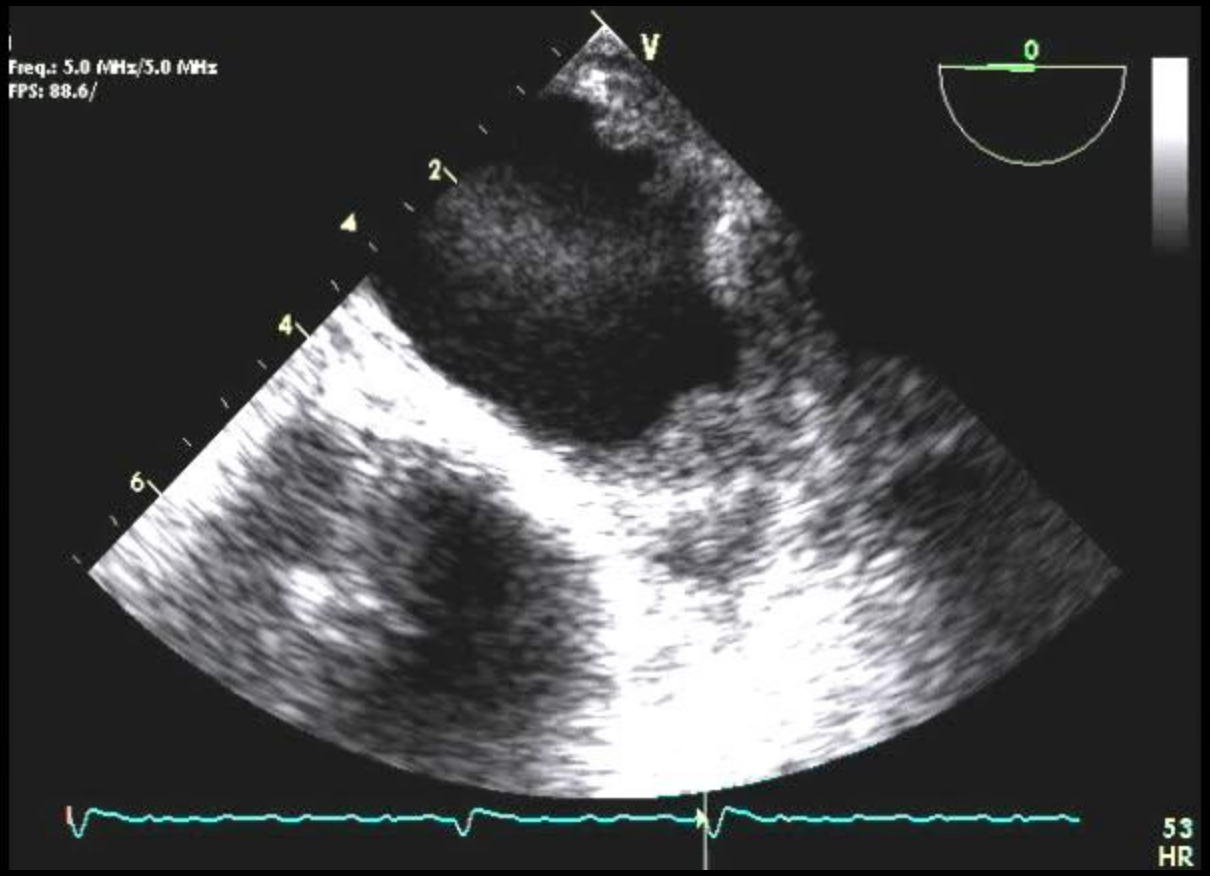
- Marfan Syndrome
- Ehlers-Danlos Syndrome
- Ankylosing Spondylitis
- Behcet disease
- Reiter Syndrome
- Williams Syndrome

Case


PAT T: 37.8C
TEE T: 37.5C

Aneurysm

Case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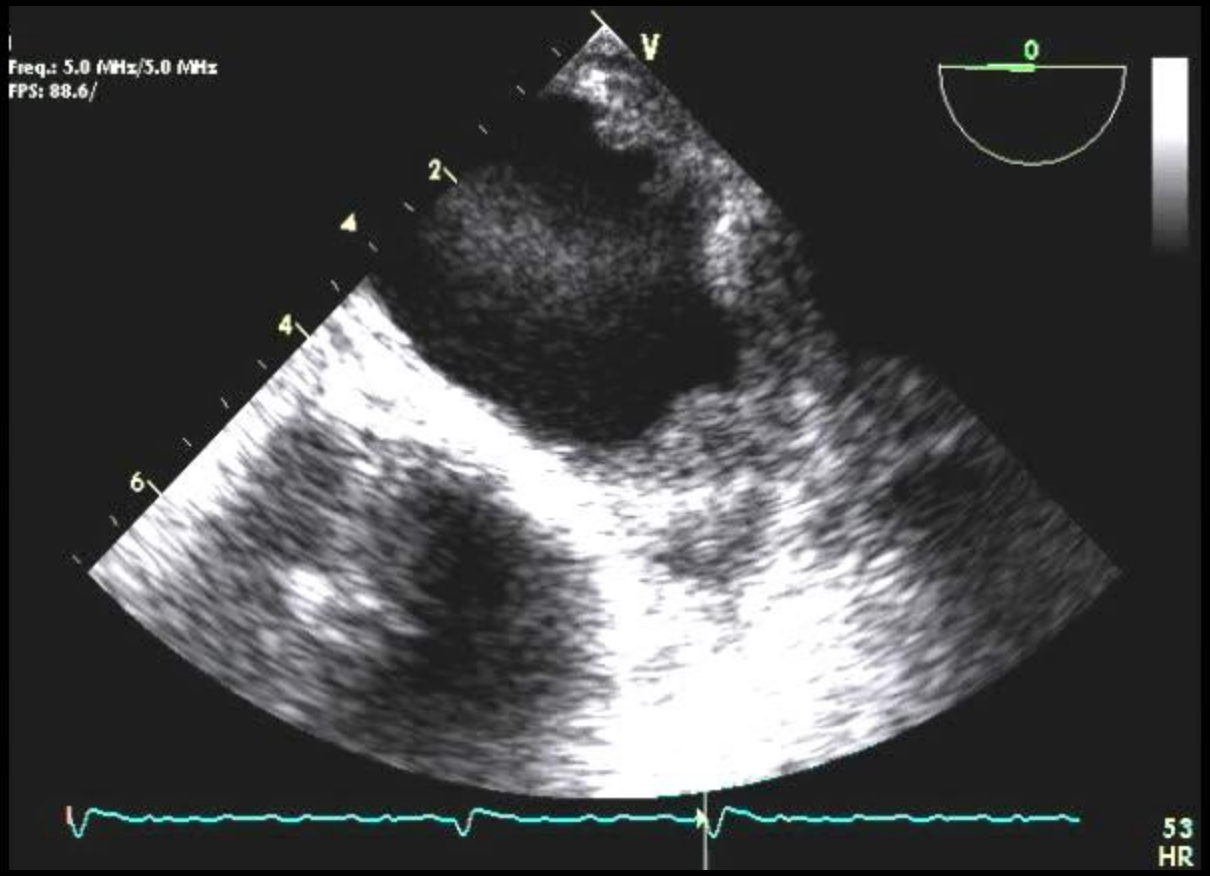
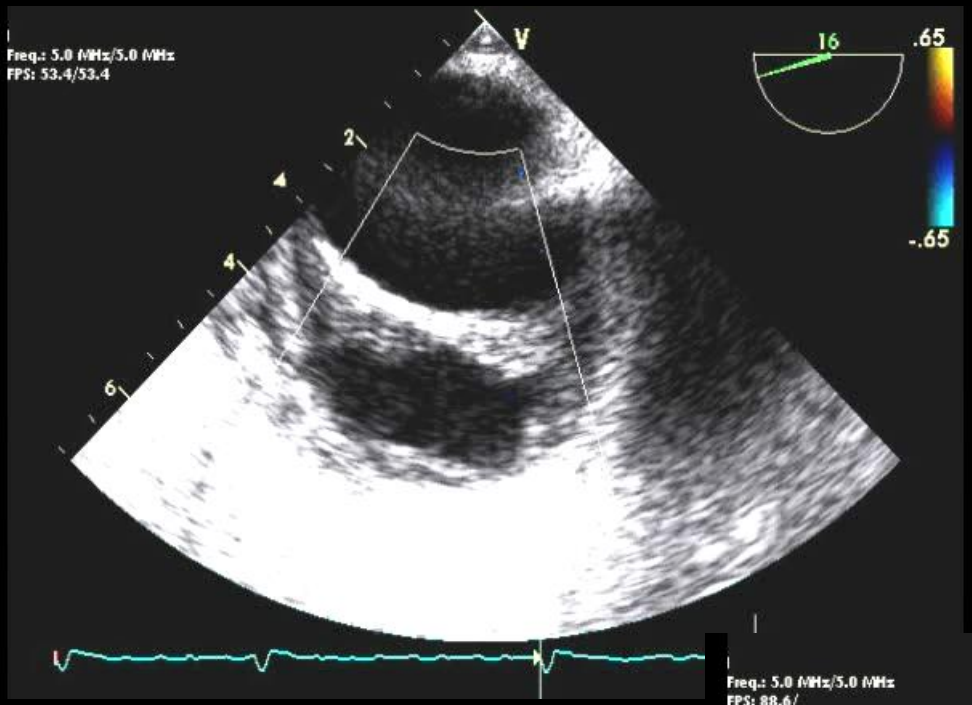
53
HR

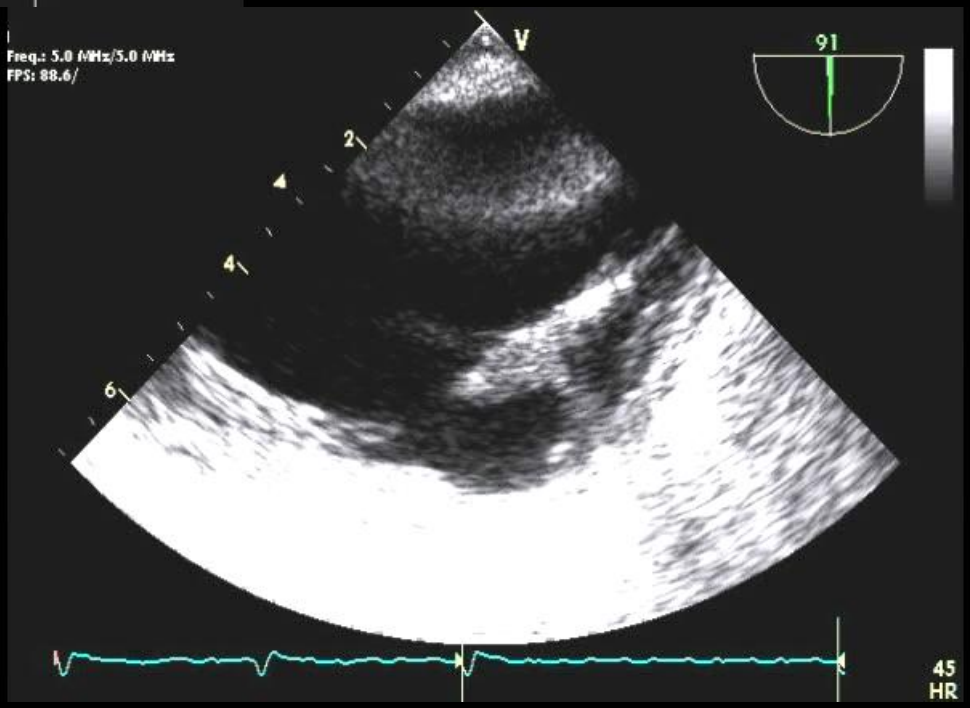


Penetrating Aortic Ulcer

Courtesy: Mankad, MD



Penetrating Aortic Ulcer



Courtesy: Mankad, MD

Penetrating Aortic Ulcer

- Atherosclerotic disease → superficial ulceration of plaque confined to intima

- Ulcer may penetrate into internal elastic lamina and into media

Penetrating Aortic Ulcer - Sequele

- Benign
- Deep ulcer (true saccular aneurysm)
- Medial hematoma
- Pseudoaneurysm
- Transmural rupture

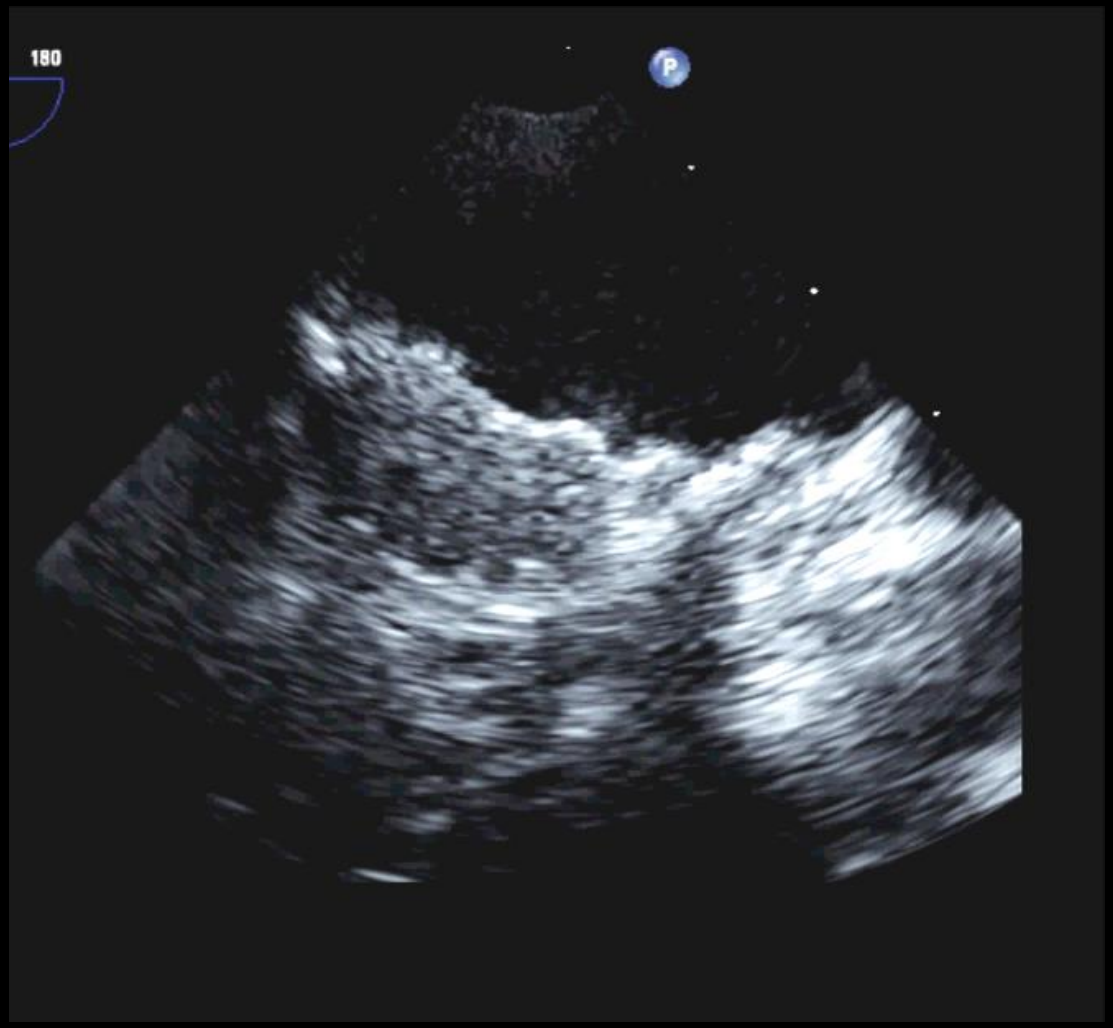
Penetrating Aortic Ulcer

- More common in descending aorta
- Elderly, hypertensive patients
- Symptoms: chest pain, back pain
- Symptomatic involvement of ascending aorta or arch has high risk for rupture→surgery
- Surgery for descending P.A.U. if:
    - Hemodynamic instability
    - Pseudoaneurysm
    - Pericardial effusion
    - Bloody pleural effusion
    - Expanding intramural hematoma

Aortic Masses

- Atheromas
- Thrombotic masses
- Tumors (sarcoma, histiocytoma, angiosarcoma)
- Mysteriomas

Case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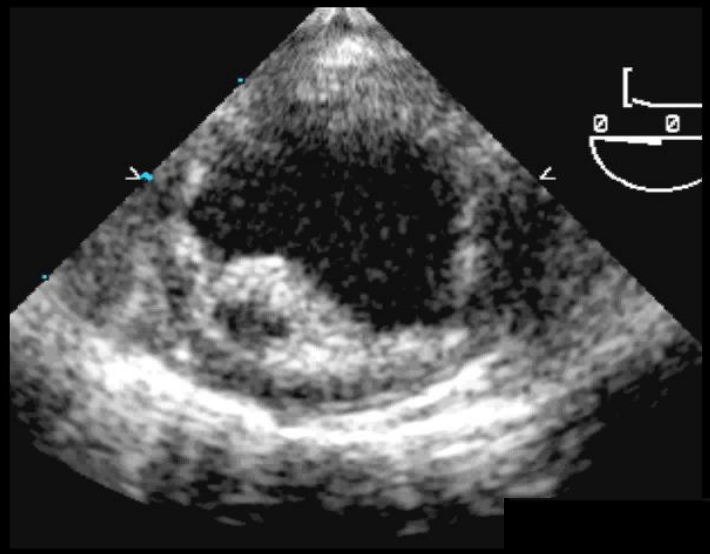
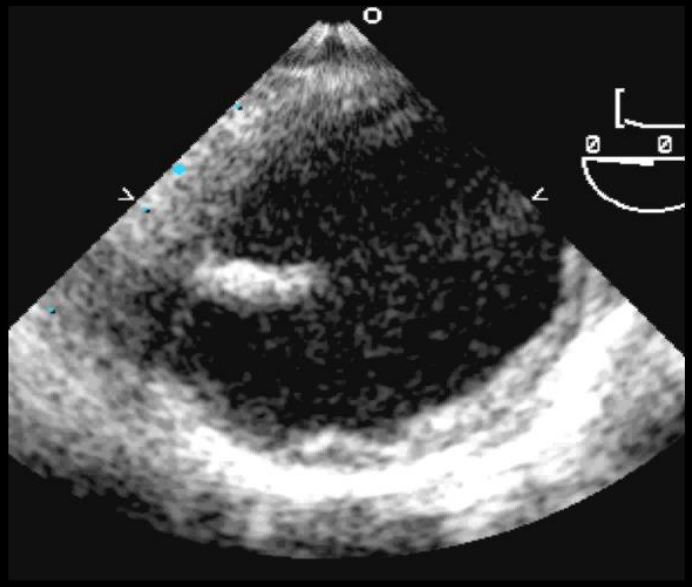
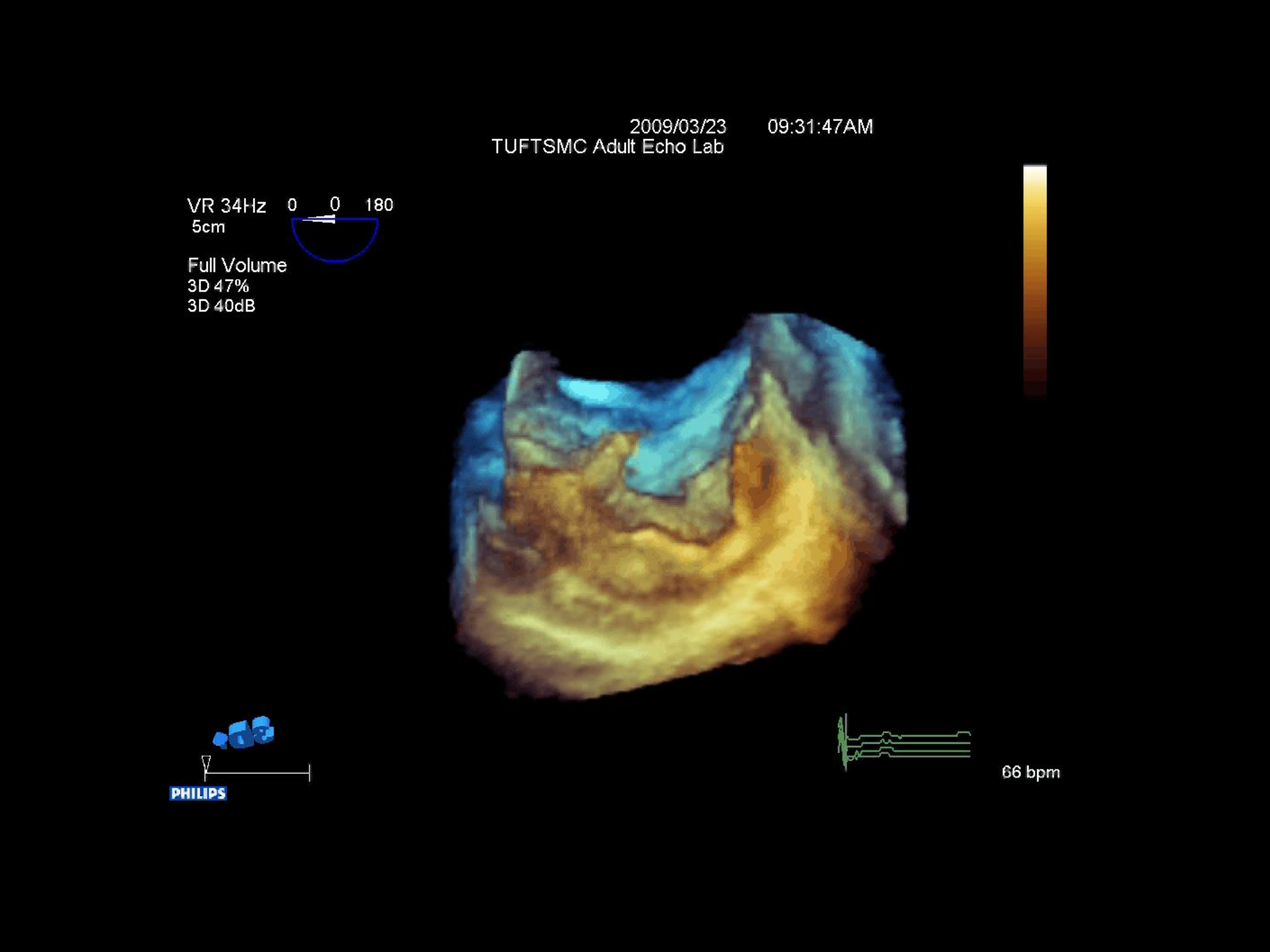
Aortic Atheroma



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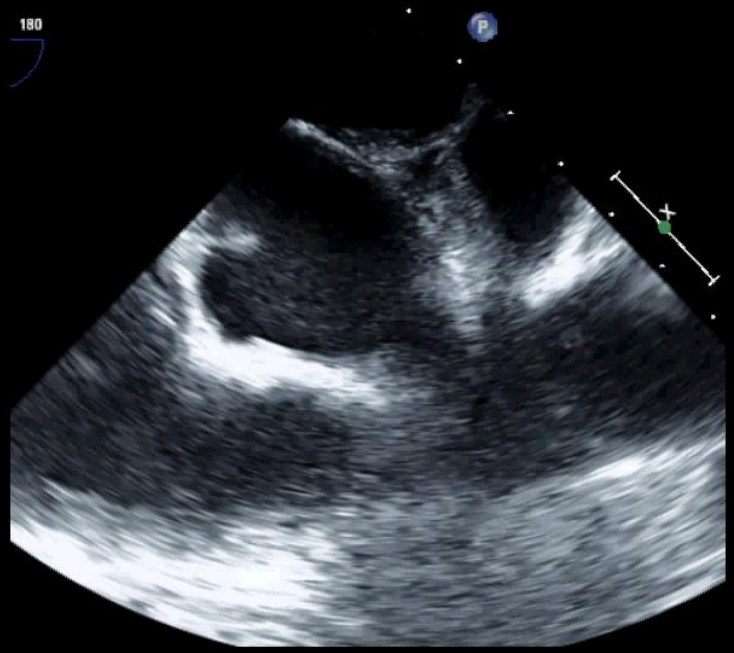
TUFTSMC Adult Echo Lab
VR 34Hz 0 0 180
5cm
Full Volume
3D 47%
3D 40dB
PHILIPS
66 bpm

Aortic Atheroma

- Association with systemic embolic events
- > 3 or >4 mm atheroma: a higher risk
- Besides Rx of dyslipidemia, other forms of therapy unproven/controversial
- Has intraoperative implications in patients undergoing aortic cannulation

Case

Case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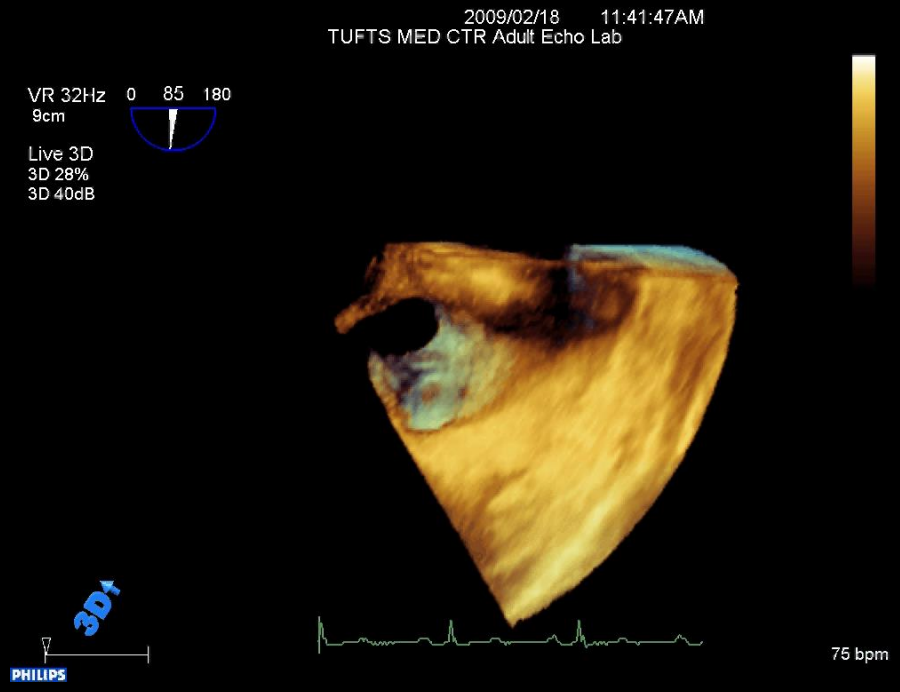
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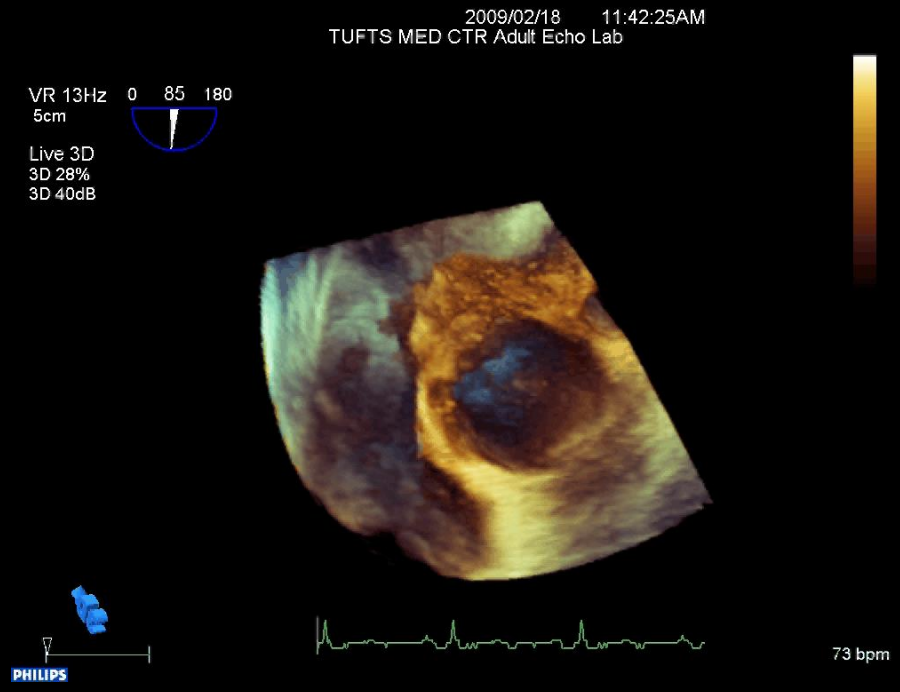
Live 3D
3D 28%
3D 40dB
75 bpm
PHILIPS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TUFTS MED CTR Adult Echo Lab
VR 13Hz 0 85 180
5cm
Live 3D
3D 28%
3D 40dB
73 bpm
PHILIPS

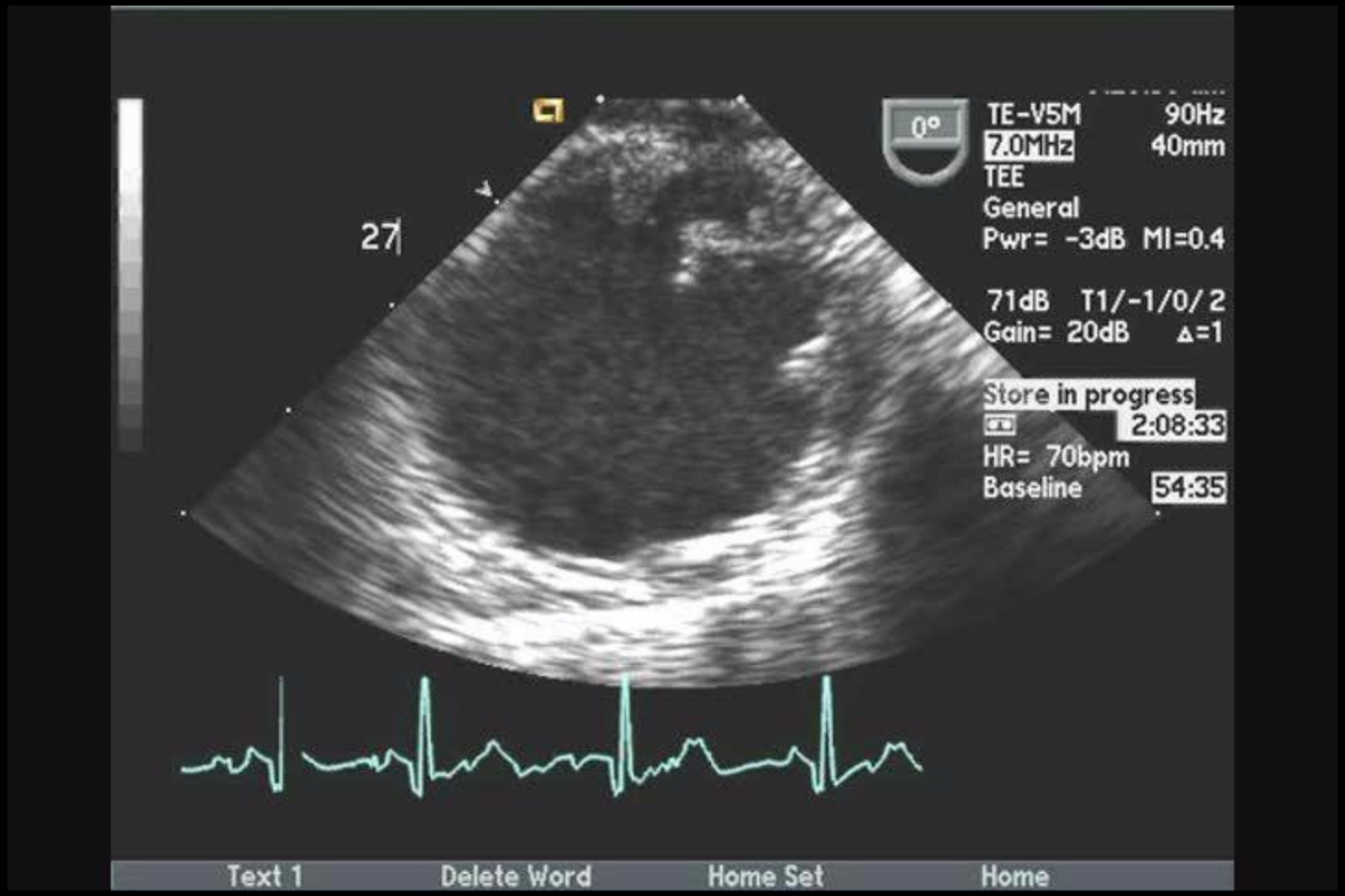
What next ?

1. Thrombus - Anticoagulate
2. Thrombus - Surgery
3. Tumor – Do more work-up
4. Tumor - Operate

What next ?

1. Thrombus - Anticoagulate
2. Thrombus - Surgery
3. Tumor – Do more work-up
4. Tumor - Operate
5. Just talk

Case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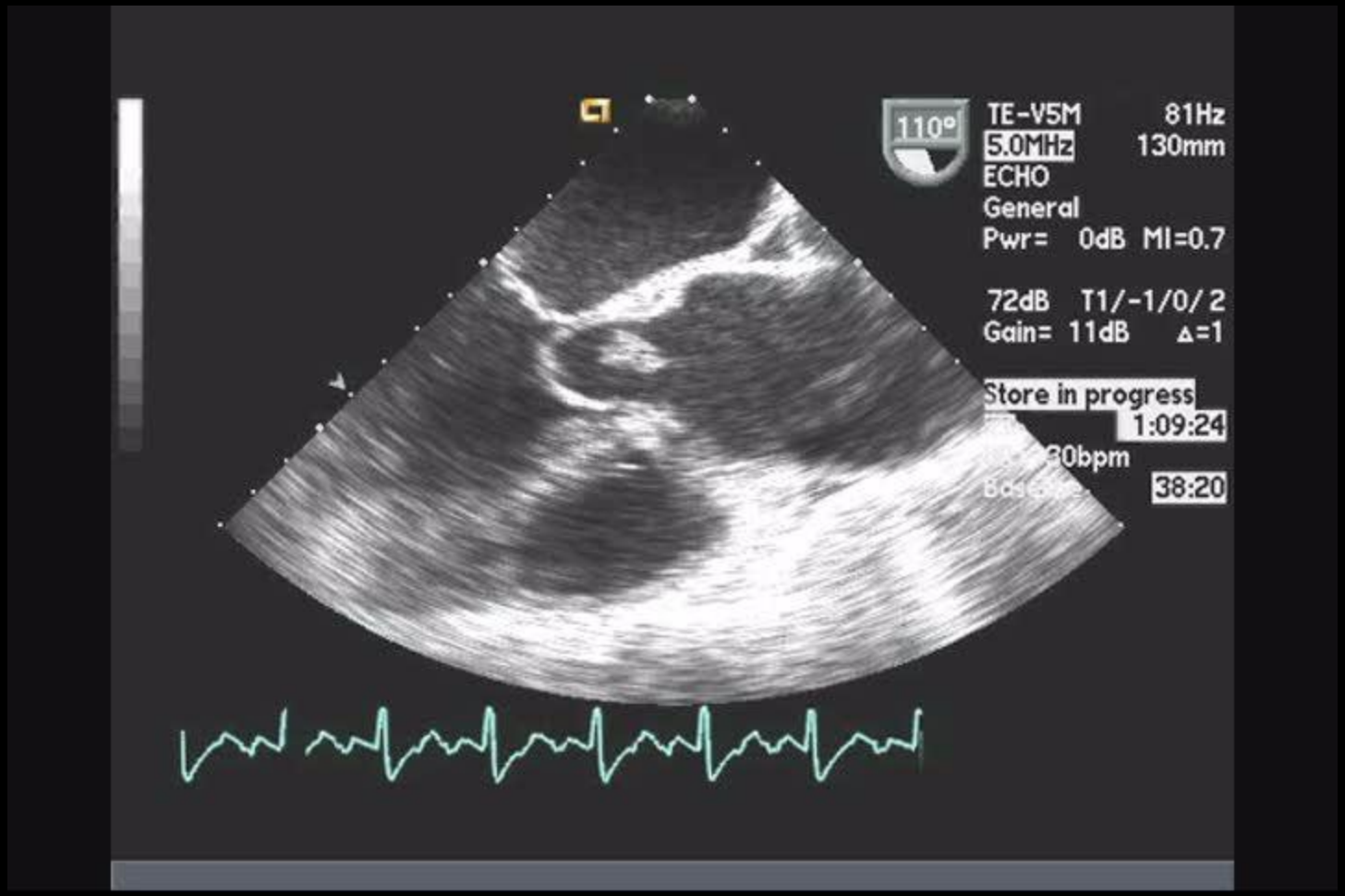
TE-V5M
90Hz
7.0MHz
40mm
TEE
General
Pwr= -3dB MI=0.4
71dB T1/-1/0/2
Gain= 20dB Δ=1
Store in progress
2:08:33
HR= 70bpm
Baseline
54:35
27
Text 1
Delete Word
Home Set
Home


110°
TE-V5M
81Hz
5.0MHz
130mm
ECHO
General
Pwr= 0dB MI=0.7
72dB T1/-1/0/2
Gain= 11dB Δ=1
Store in progress
1:09:24
38:20

Aortic Trauma

- **High Mortality (20% survival to hospital)**
- **Horizonal deceleration injury** (MVA)
- **Vertical decel injury** (falling from height)
- **Most common sites**:

  Aortic isthmus tethered by ligamentum arteriosum

  Ascending aorta above sinus of valsalva

  Origin of the innominate artery

Diagnosis of Aortic Trauma

Angiography—transport of patient, risk of worsening vascular trauma

CT—requires transport of patient

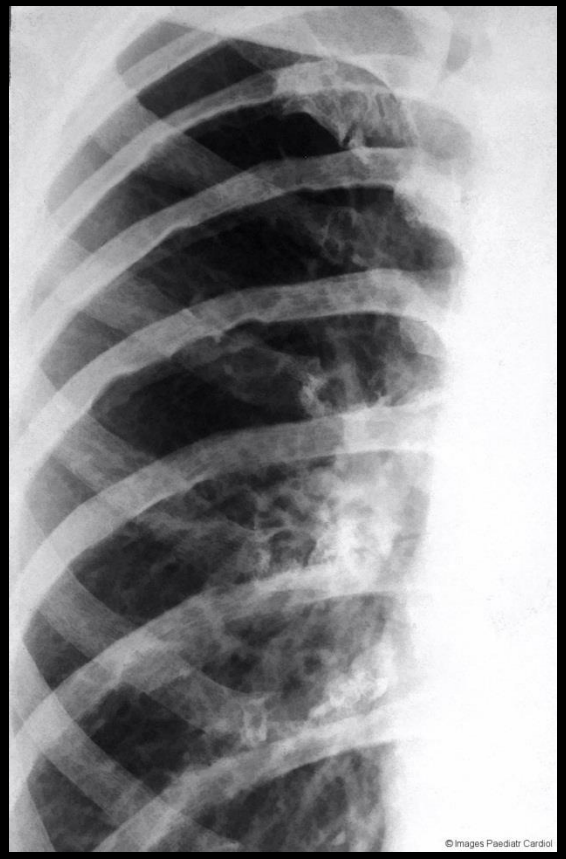
TEE

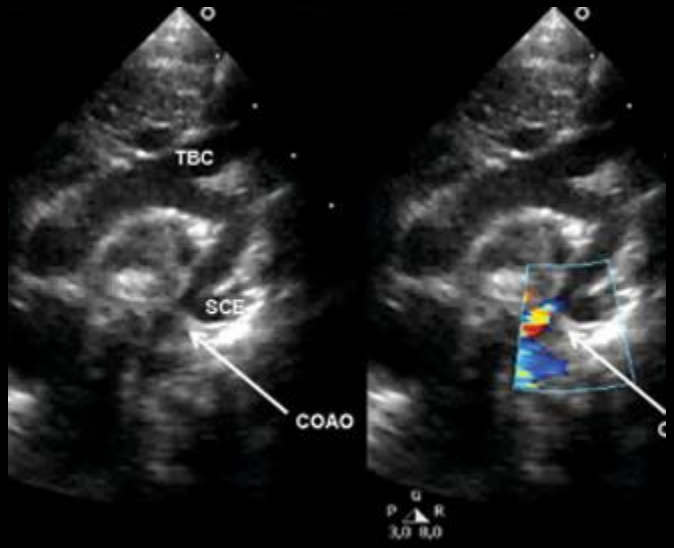
- Cannot be performed in severe facial injury or cervical spine injury
- May not see distal ascending aorta or great vessels

Echo Findings in Aortic Trauma

- “thick stripe” due to deep laceration
- Pseudoaneurysm
- Fusiform dilation
- Intramural hematoma
- Intraluminal thrombi
- Mediastinal hematoma

Case


© Images Paediatr Cardiol


TBC
SCE
COAO
P
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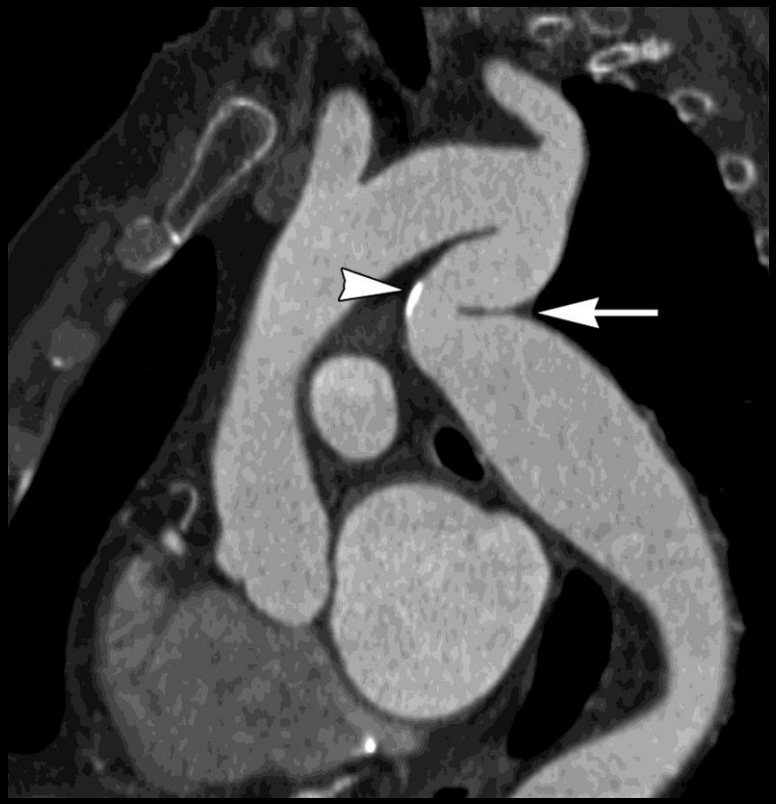
3,0
8,0

Coarctation of the Aorta

- Pre-ductal, Ductal or Post-ductal
- If hypertensive/symptomatic,
  Angioplasty/stent or surgery

Pseudo-coarctation of the Aorta



Kimura-Hayama E T et al. Radiographics 2010;30:79-98

Thank You