

Aortic Dissection

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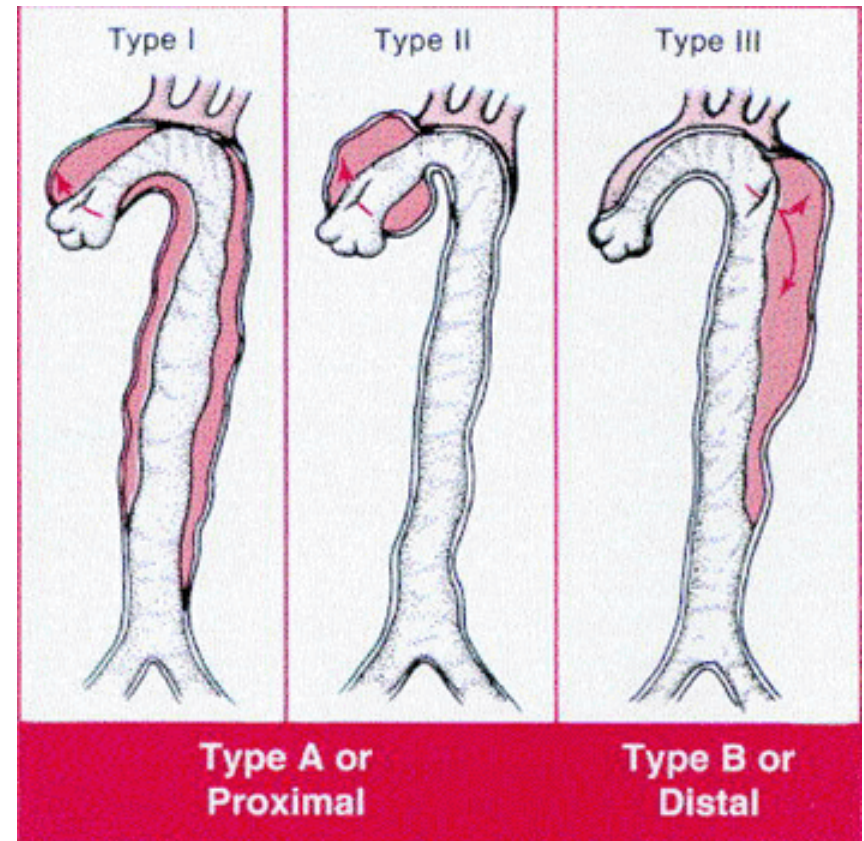
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Background

- Incidence of 1 in 2000 in US
- Early mortality of 1%/hour for proximal dissection
- Two theories of formation
 - Breach of intimal layer of aorta allows blood to encroach on a diseased medial layer, creating a false lumen and intimal flap.
 - Rupture of vasa vasorum in medial layer causes local hematoma causing dissection; no flap is formed. 13% of autopsy cases cannot identify flap.

Classification

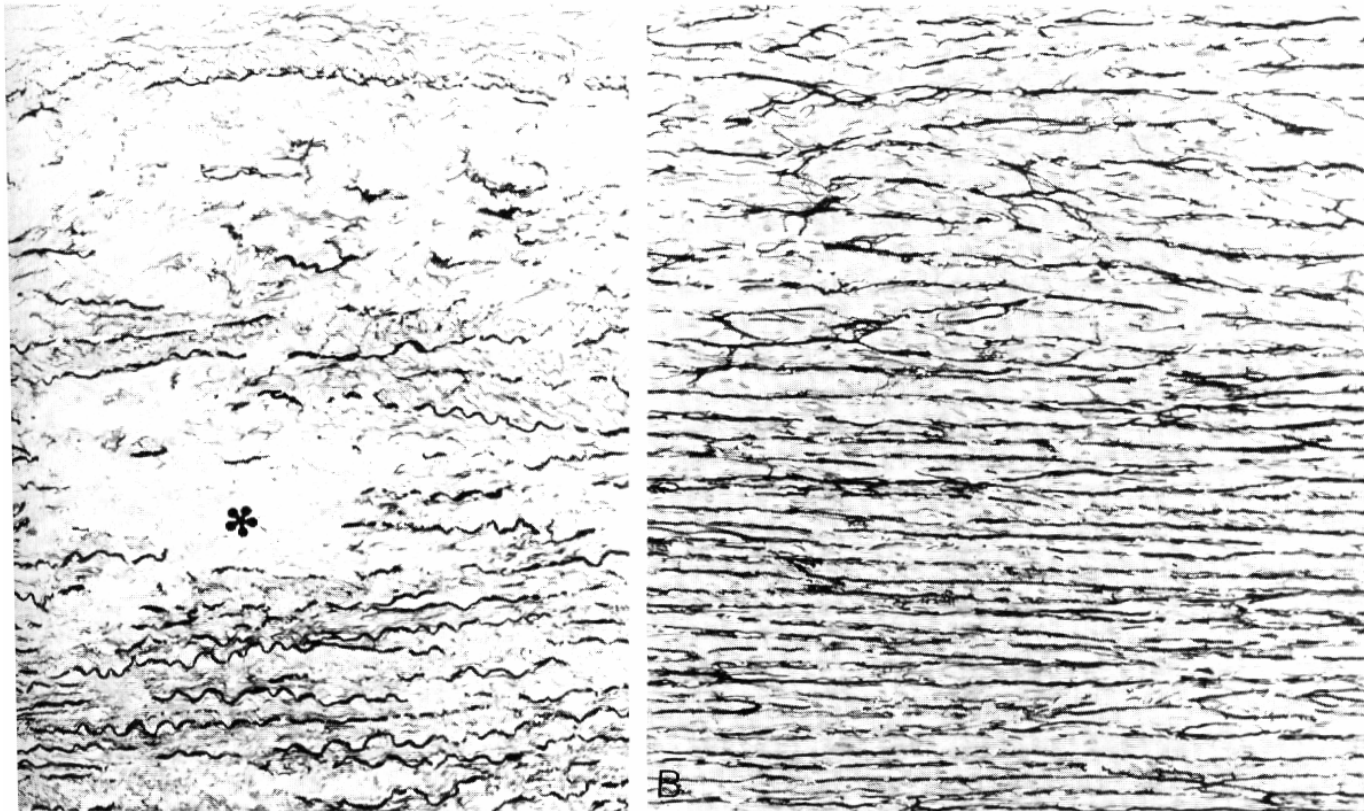
- Anatomic
 - DeBakey
 - Types 1, 2, 3
 - Stanford
 - Types A, B
 - Descriptive
 - Proximal, Distal
- Temporal
 - Acute, <2 weeks (2/3)
 - Chronic, >2weeks (1/3)



Etiology

- Medial degeneration
 - Chief cause of atraumatic dissections
 - Marfan syndrome
 - 5-9% of all aortic dissections
 - Dissections occur at a young age
 - Thoracic aortic aneurysms
 - Proximal aortic dissections
 - Ehlor's-Danlos syndrome
 - Familial aortic aneurysm
 - Mutation of fibrillin-1 gene with loss of elastic fibers
 - Nonclassic degeneration associate with age, hypertension

Cystic Medial Necrosis



Left from a patient with Marfan syndrome, shows disruption of elastic lamellae in aortic medial layer, with areas completely devoid of elastin (*). Right is normal medial layer.

Etiology

- Peak incidence age 60's to 70's
- M:F 2:1
- 72-80% with preexisting hypertension
- Bicuspid aortic valve found in 7-14% of all aortic dissections
- Associated with Noonan, Turner syndromes
- Vasculitis, especially giant cell
- Reports describe association with cocaine in young men

Pregnancy and Aortic Dissection

- Of aortic dissections in women <40, half are during pregnancy
- Generally in the third trimester
- Some in postpartum
- Marfan syndrome poses special risk
- Uncertain causality; not fully explained by increases in BP, CO, blood volume
- Possible reporting bias

Trauma

- Blunt trauma usually causes tear, hematoma or transection; not usually dissection
- Cardiac catheterization, Balloon pump can cause intimal tear
- Cardiac surgery carries small risk
 - Up to 18% of patients with dissection have history of cardiac surgery
 - Aortic valve replacement carries highest risk

Symptoms

Common Manifestations

- Severe “tearing” pain, usually sudden onset
- Migratory pain described in 17% of cases
- Location
 - Ascending aorta
 - Anterior pain involves ascending aorta in 90% of cases
 - Neck, throat, jaw, face
 - Descending aorta
 - Interscapular pain involves descending aorta in 90% of cases
 - Back, abdomen, lower extremity pain

Symptoms

Uncommon Manifestations

- Syncope (9%)
- Congestive heart failure (7%)
 - Due to acute aortic regurgitation
- CVA (5%)
- Peripheral neuropathy
- Paraplegia
- Sudden death
- Tamponade (hemopericardium due to rupture)

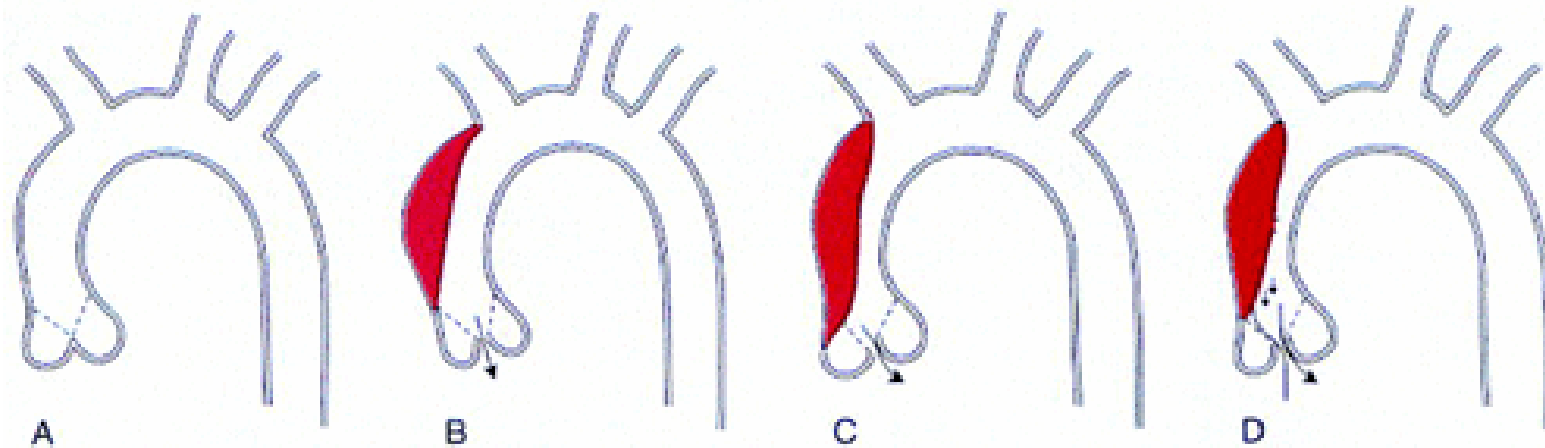
Blood Pressure

- Hypertension
 - In distal dissection, 70%
 - In proximal dissection, 36%
- Hypotension
 - Distal, 4%
 - Proximal, 25%
 - Usually caused by tamponade, aortic regurgitation, pleural or peritoneal rupture
 - Dissection may occlude brachiocephalic artery

Physical Findings

- Pulse deficit
- Aortic regurgitation
 - 32% of proximal dissections
 - Actual regurgitation occurs in 50-66% of proximal dissections
- Neurologic
 - Abnormalities in 6-19% of all dissections
- Pleural Effusion

Mechanism of Aortic Regurgitation

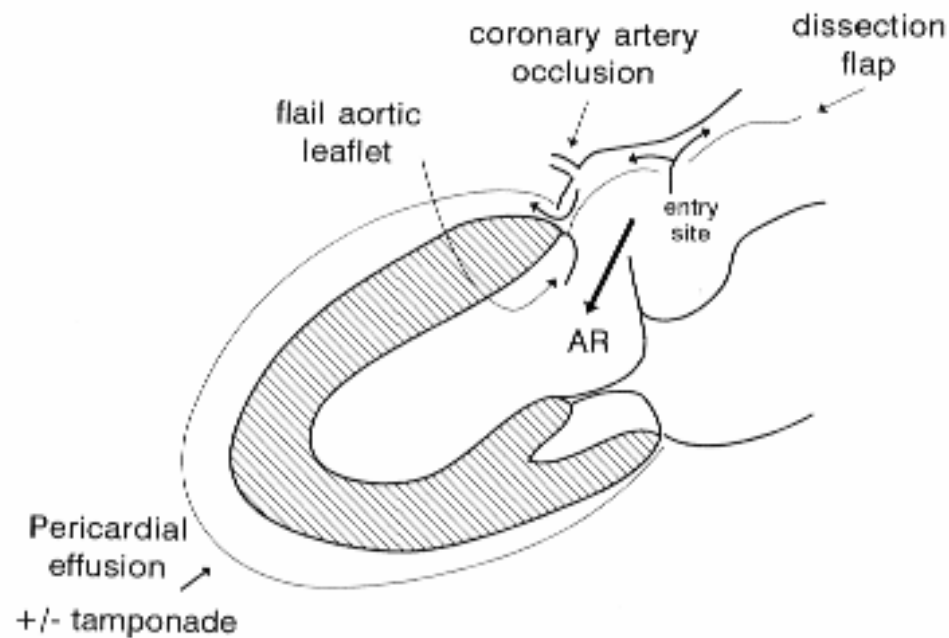


- A – Normal anatomy, leaflets suspended from sinotubular junction
- B – Dilated ascending aorta widens sinotubular junction
- C – Leaflet detaches from commissural attachment, leaflet prolapse occurs
- D – Extensive dissection, flap prolapses across valve

Dissection Extension

- Proximal dissection involves coronary artery in 1-2% of cases
 - Most commonly flap involves **right coronary** ostium, causing inferior infarct
 - Chest xray may not be sufficient to rule out dissection
- Distal dissection can extend
 - 5-8% of cases involve renal artery
 - 3-5% involve mesenteric ischemia/infarction

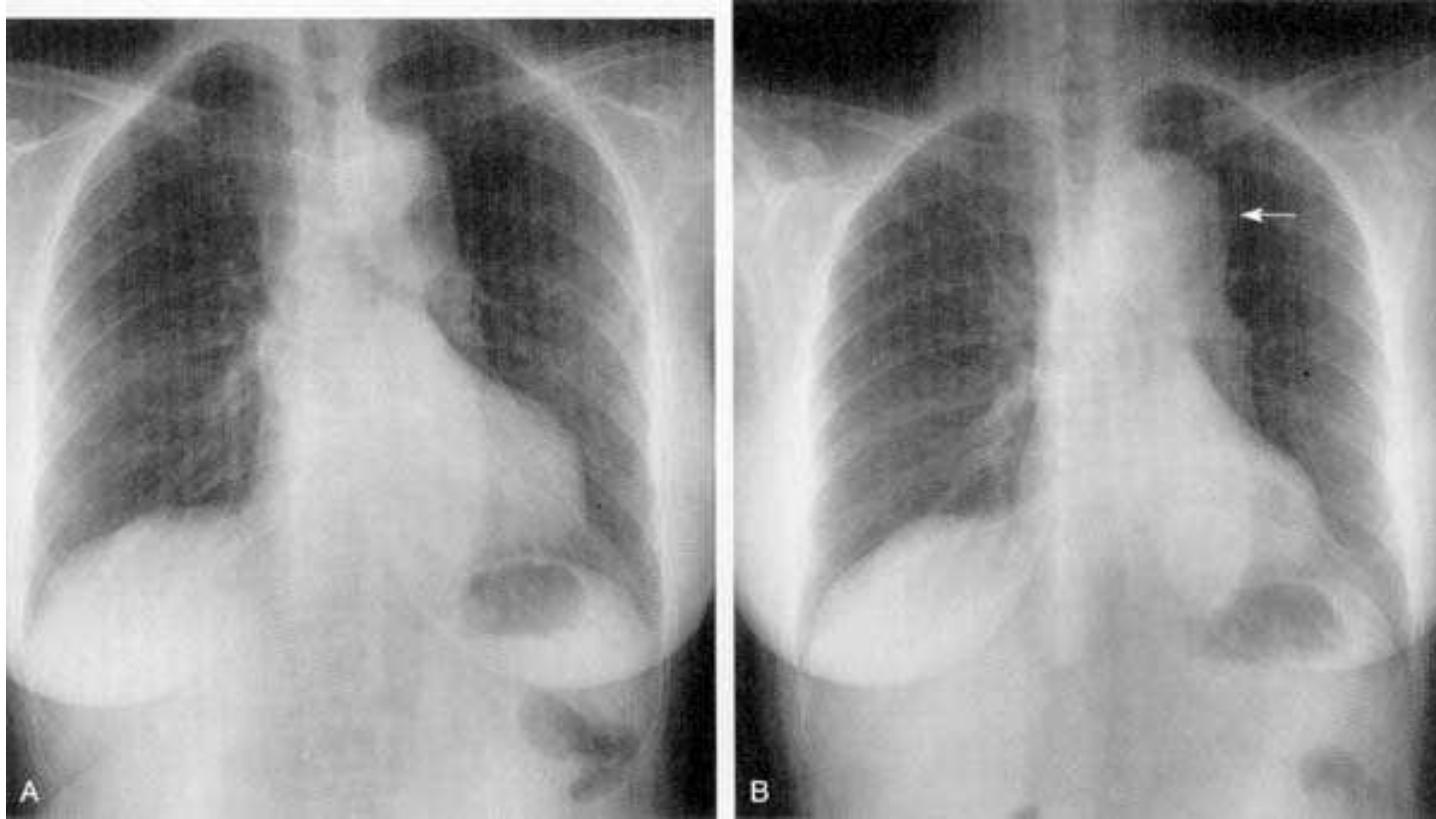
Proximal Complications



Labs

- Chest Xray
 - 81-90% show widening of aortic silhouette
 - Calcified intima separated 1.0cm from outer soft tissue border suggests dissection
 - Plural effusion common, often **left side**
 - **12% have normal chest xray**
- EKG - nonspecific
 - 1/3 LVH, 1/3 normal
 - Evaluate for myocardial infarction
- Monoclonal antibodies to smooth muscle myosin heavy chains
 - Tested in 27 patients within 12 hours of acute dissection
 - **90% sensitive, 97% specific**

Chest Xray



- A – Baseline study 3 years prior
- B – Aortic knob widened (arrow), proximal aortic dissection

Diagnostic Techniques

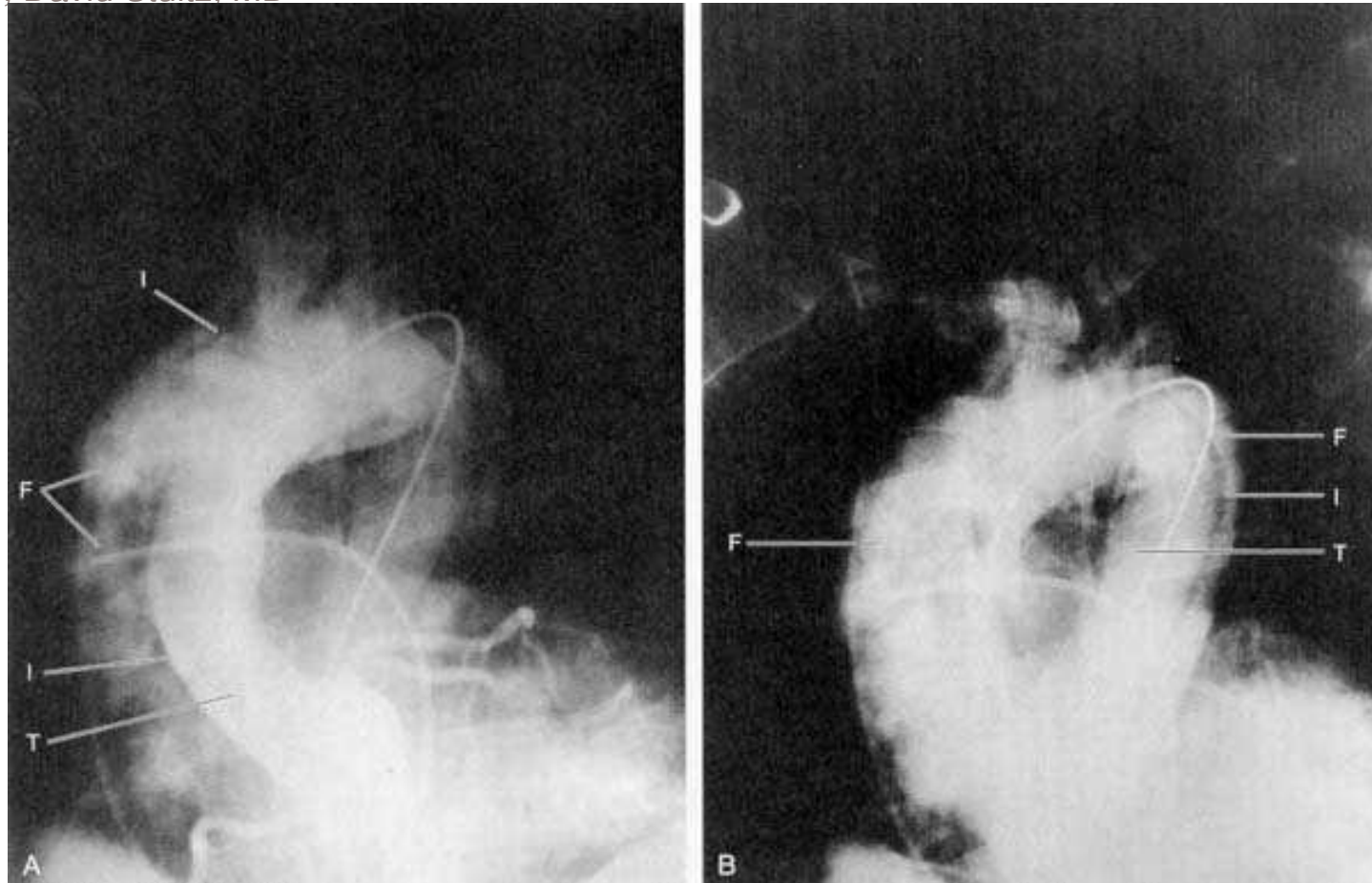
- Aortography
- Contrast enhanced CT
- MRI
- Transthoracic echocardiogram
- Transesophageal echocardiogram

Aortography

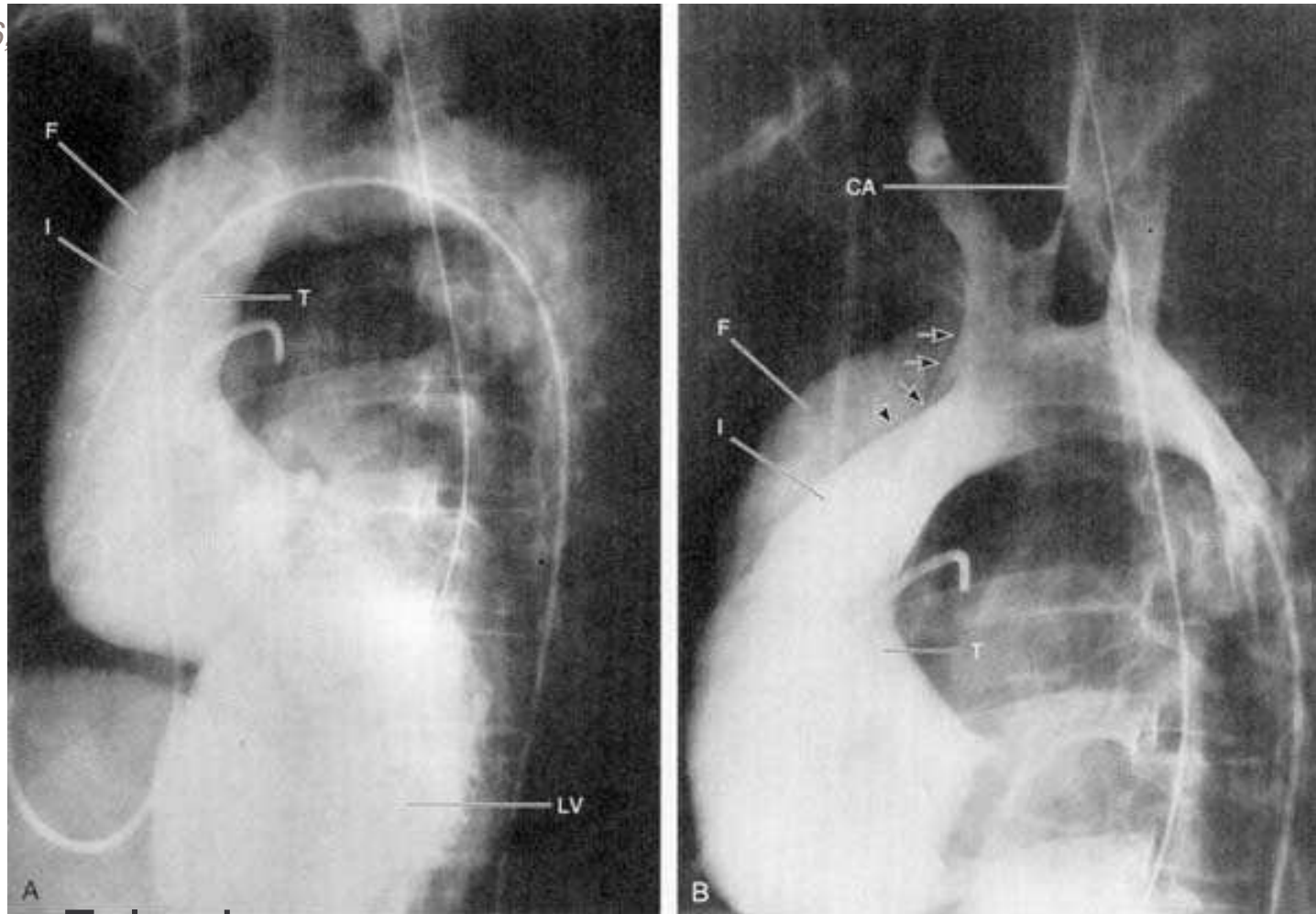
- Previous gold standard
 - However, only 77-88% sensitive
- Direct signs
 - Two lumens (87%)
 - Intimal flap (70%)
- Indirect signs
 - Deformed aortic lumen
 - Thickened walls
 - Branch vessel abnormalities
 - Aortic regurgitation

Aortography

- Advantages
 - Extent of involvement
 - Detects aortic regurgitation
 - Screens for coronary involvement
- Disadvantages
 - Suboptimal sensitivity
 - Invasive, requires lab and team
 - Contrast exposure
 - Cannot visualize intramural hematoma



- F – False Lumen
- I – Intimal Flap
- T – True Lumen



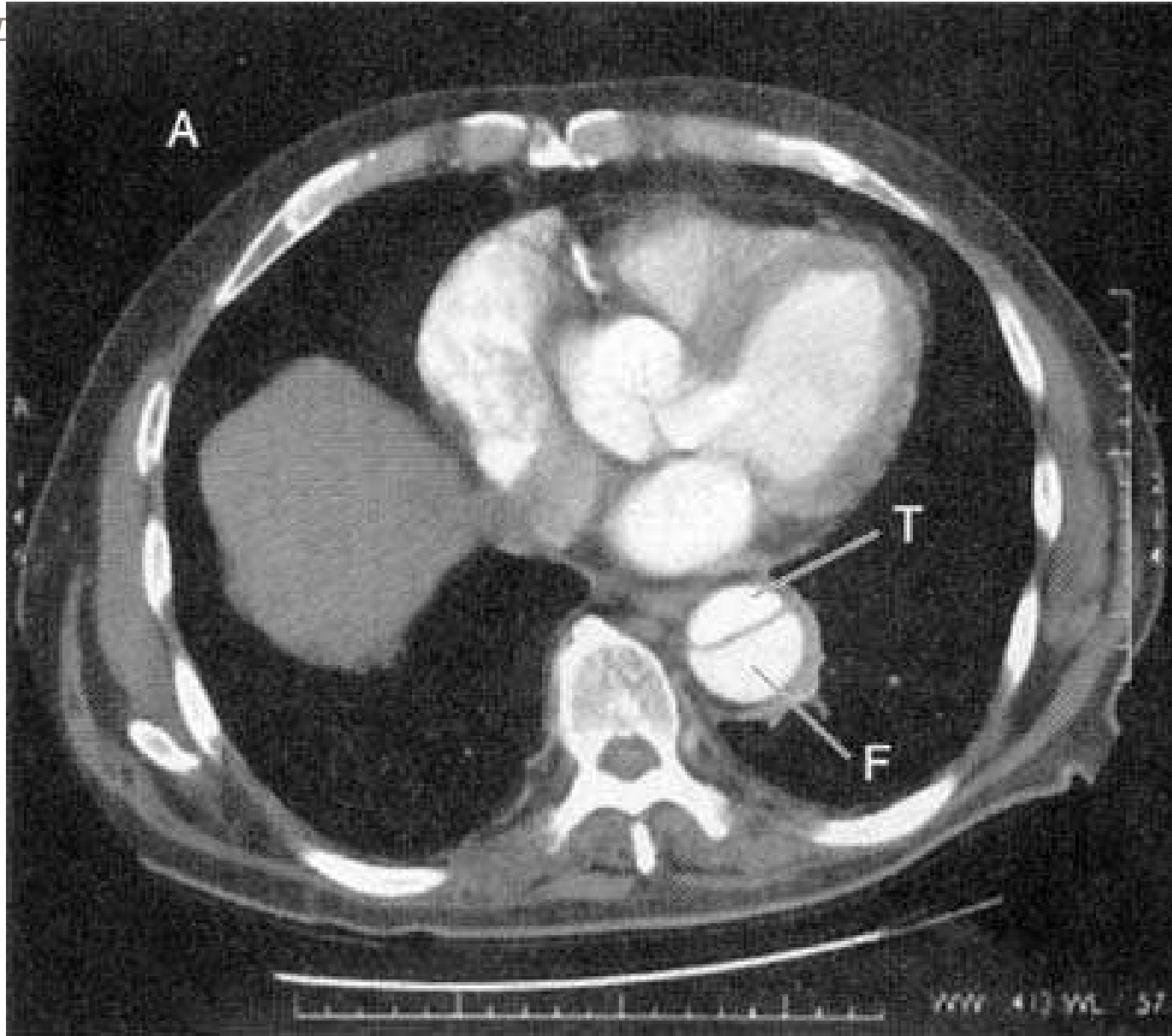
- F – False Lumen
- I – Intimal Flap (also arrows)
- T – True Lumen
- CA – Carotid Artery

CT

- Must visualize two lumens in aorta
 - Separated by flap
 - Differential contrast opacification
- 83-94% sensitive, 87-100% specific
- Spiral CT technique enhances sensitivity and specificity

CT

- Advantages
 - Noninvasive
 - Readily available
 - Can visualize intramural hematoma
- Disadvantages
 - IV contrast
 - Rarely identifies site of intimal tear
 - Cannot detect aortic regurgitation



CT of descending aortic dissection

MRI

- Current gold standard
- High resolution images in multiple planes
- 98% sensitivity and specificity
- 88% sensitive for identifying site of intimal tear
- Cine-MRI 85% sensitive for aortic regurgitation

MRI

- Advantages
 - High sensitivity and specificity
 - Completely noninvasive
- Disadvantages
 - Contraindicated with pacemakers, metal
 - Limited monitoring
 - Not suitable for unstable patient



MRI of descending thoracic aortic dissection

Echocardiography

- Views intimal flap with separation of true and false lumens
- Should be seen in several views
- Doppler should demonstrate differential flow in lumens
- Transthoracic
 - 59-85% sensitive
 - 63-96% specific
- IVUS
 - More useful in abdominal aorta

Transthoracic echocardiography

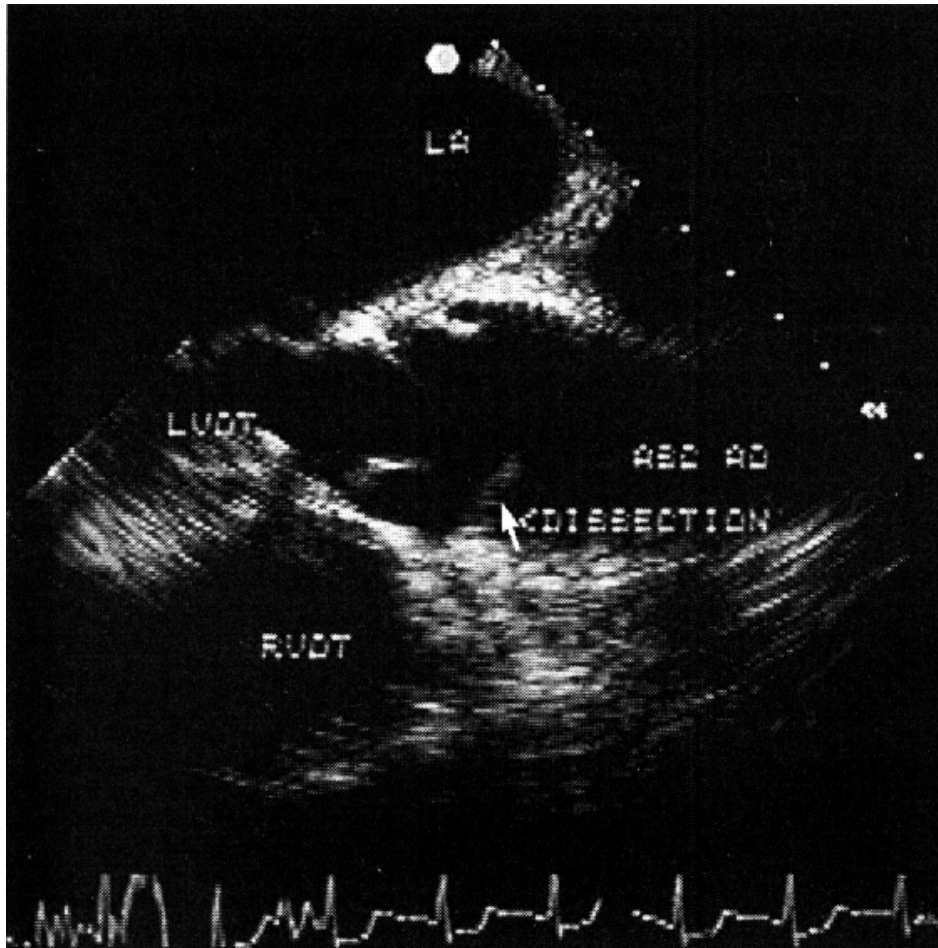
- See mobile linear structure in a dilated aorta
 - Artifact will decrease specificity
- Low sensitivity, due to poor resolution of ascending and descending aorta
- Can observe aortic regurgitation
- Wall motion may be compromised when coronary artery is involved
- When clinical suspicion is *low*, TTE may be sufficient to *almost* rule out dissection
- When clinical suspicion is moderate or high, TTE is inappropriate as a screening test

Transesophageal echocardiography

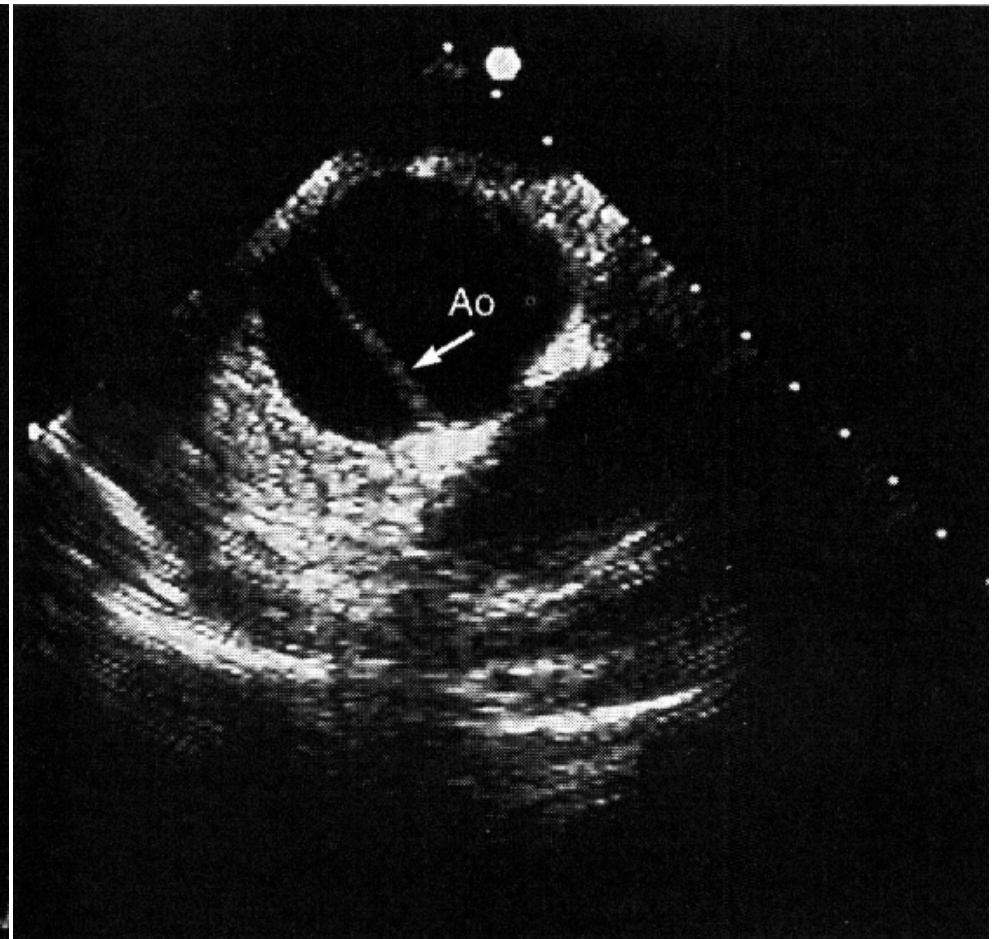
- 98-99% sensitivity
- 94-95% specificity with biplane
- 73% sensitive for detecting intimal flap
- 100% sensitive for aortic regurgitation and pericardial effusion

Transesophageal echocardiography

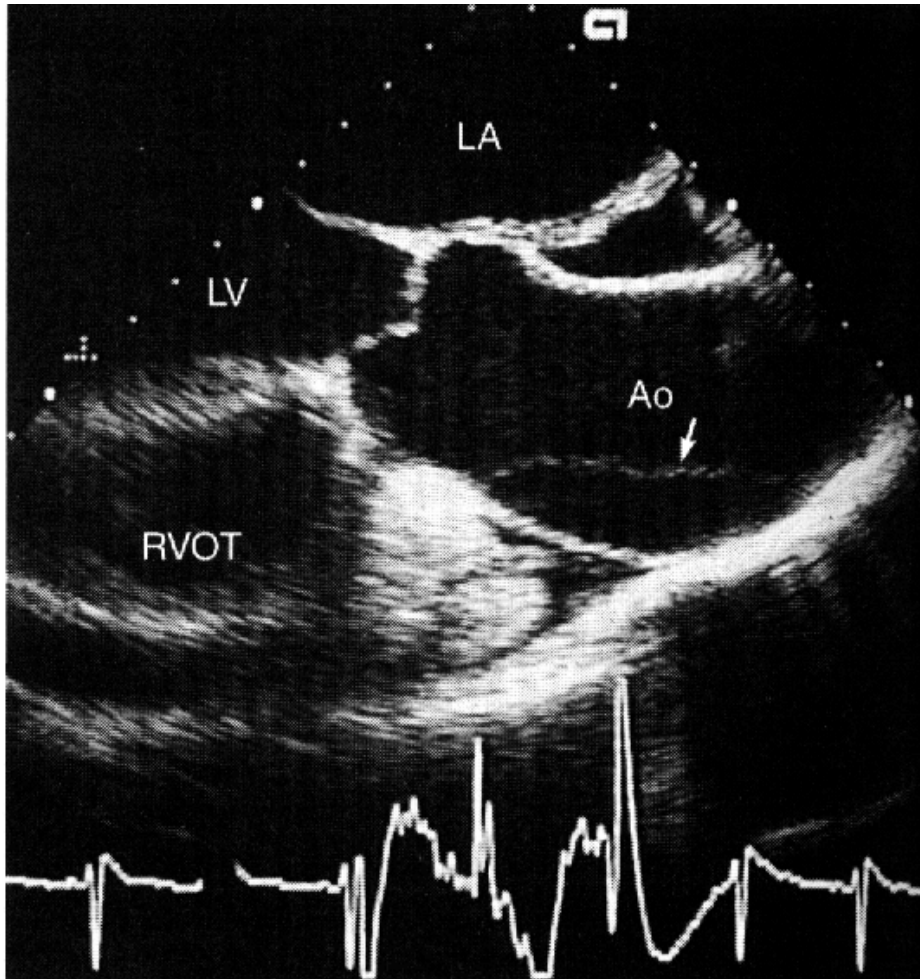
- Visualize linear, bright echogenic flap in aortic lumen with erratic motion
- Doppler can visualize blood flow in both true and false lumens
- Proximal aortic root visualized in short-axis at aortic valve level
- Ascending aorta visualized in long axis



Transesophageal long axis



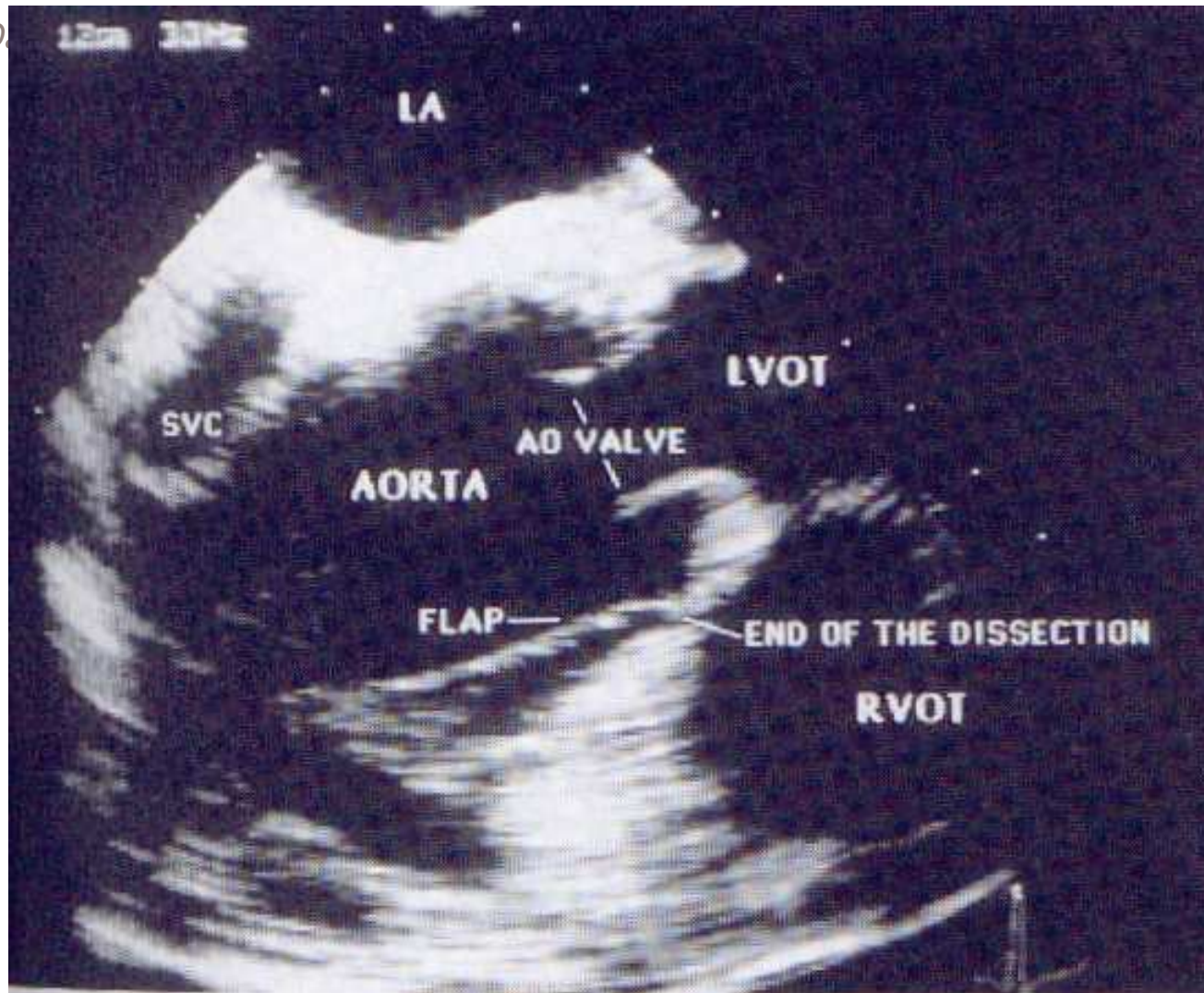
Transesophageal short axis



Transesophageal long axis



Transesophageal long axis
Color flow doppler

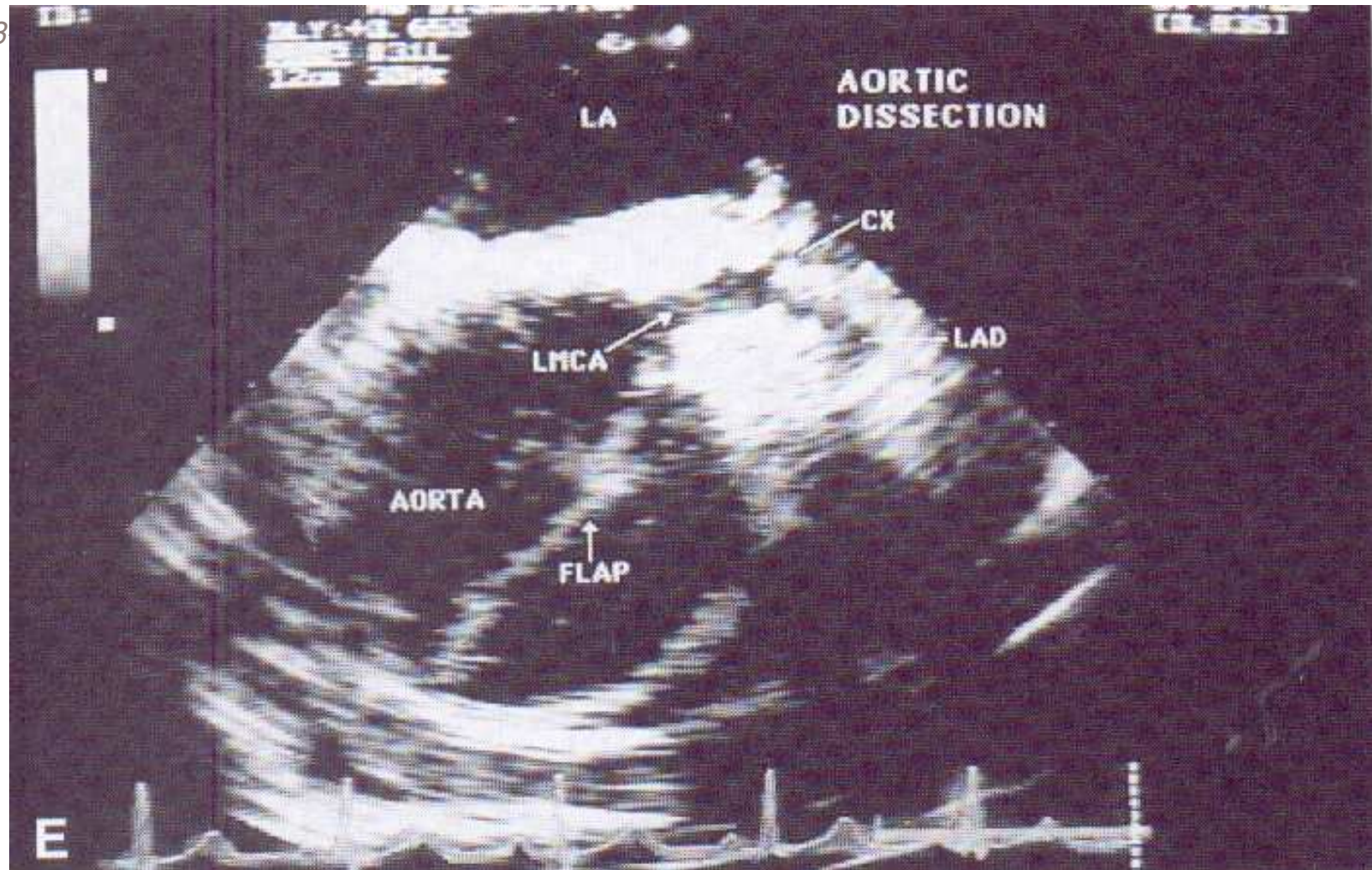


Dissection flap in ascending aorta but not involving valve leaflets

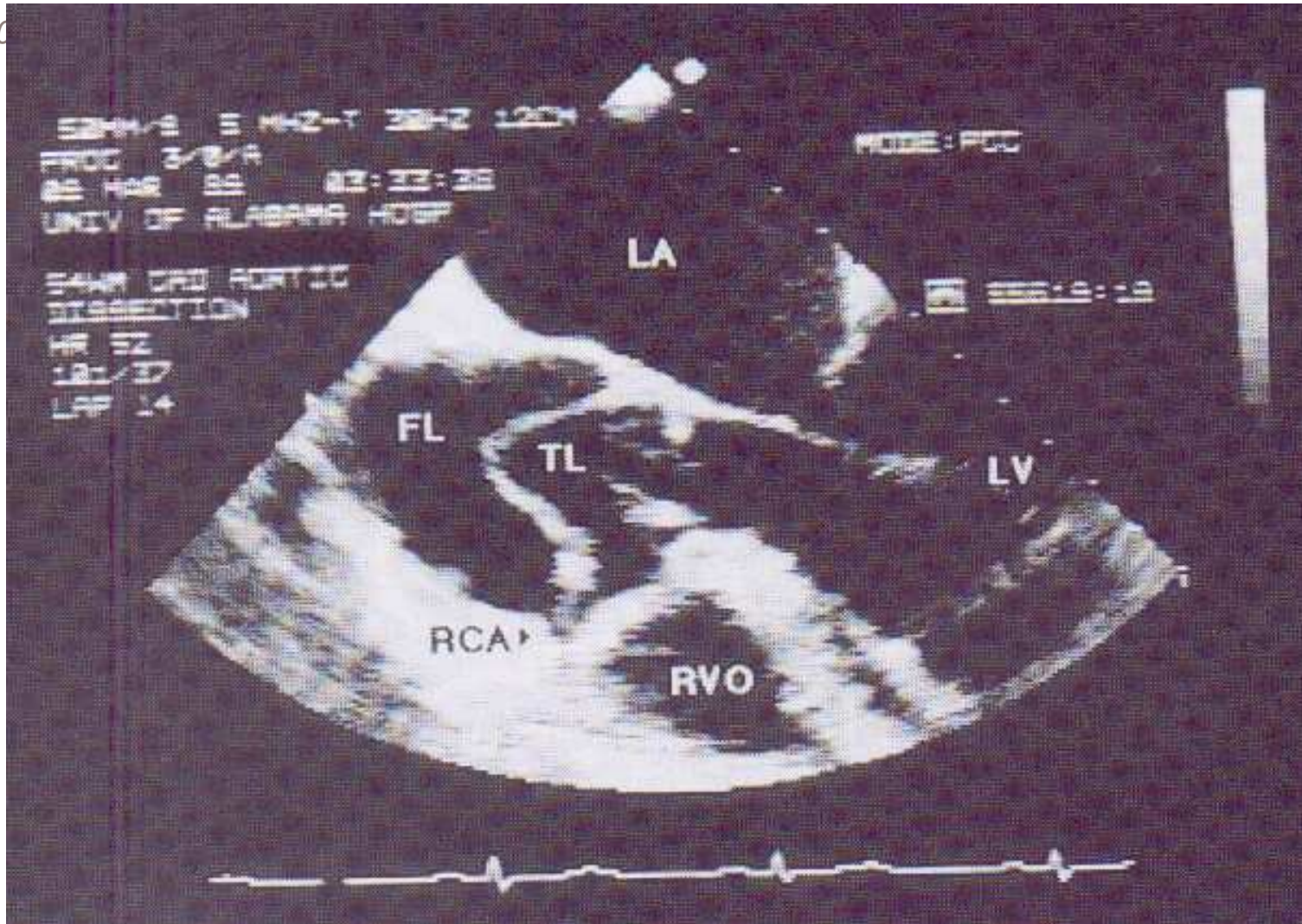


Prolapse of a dissection flap

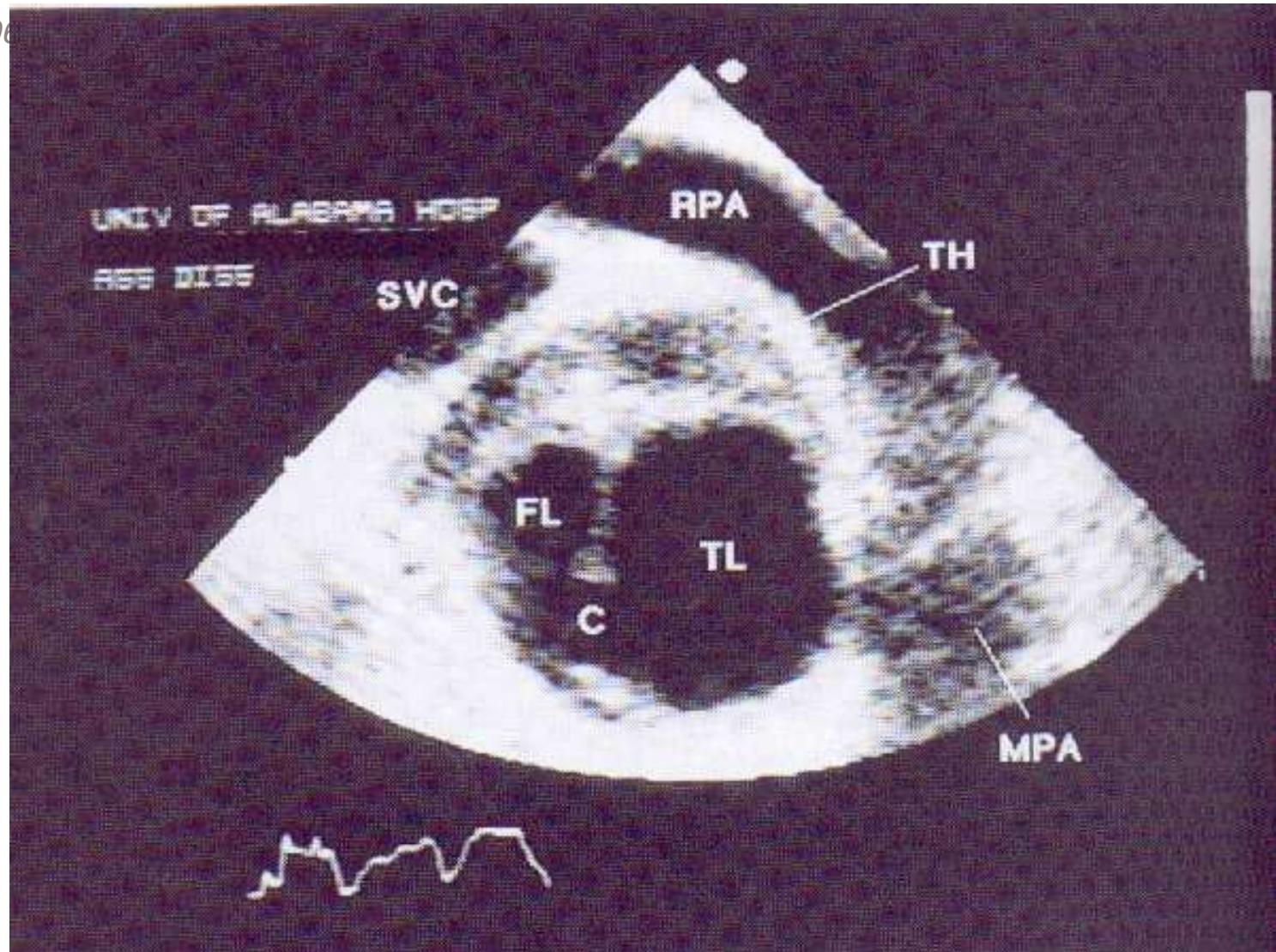
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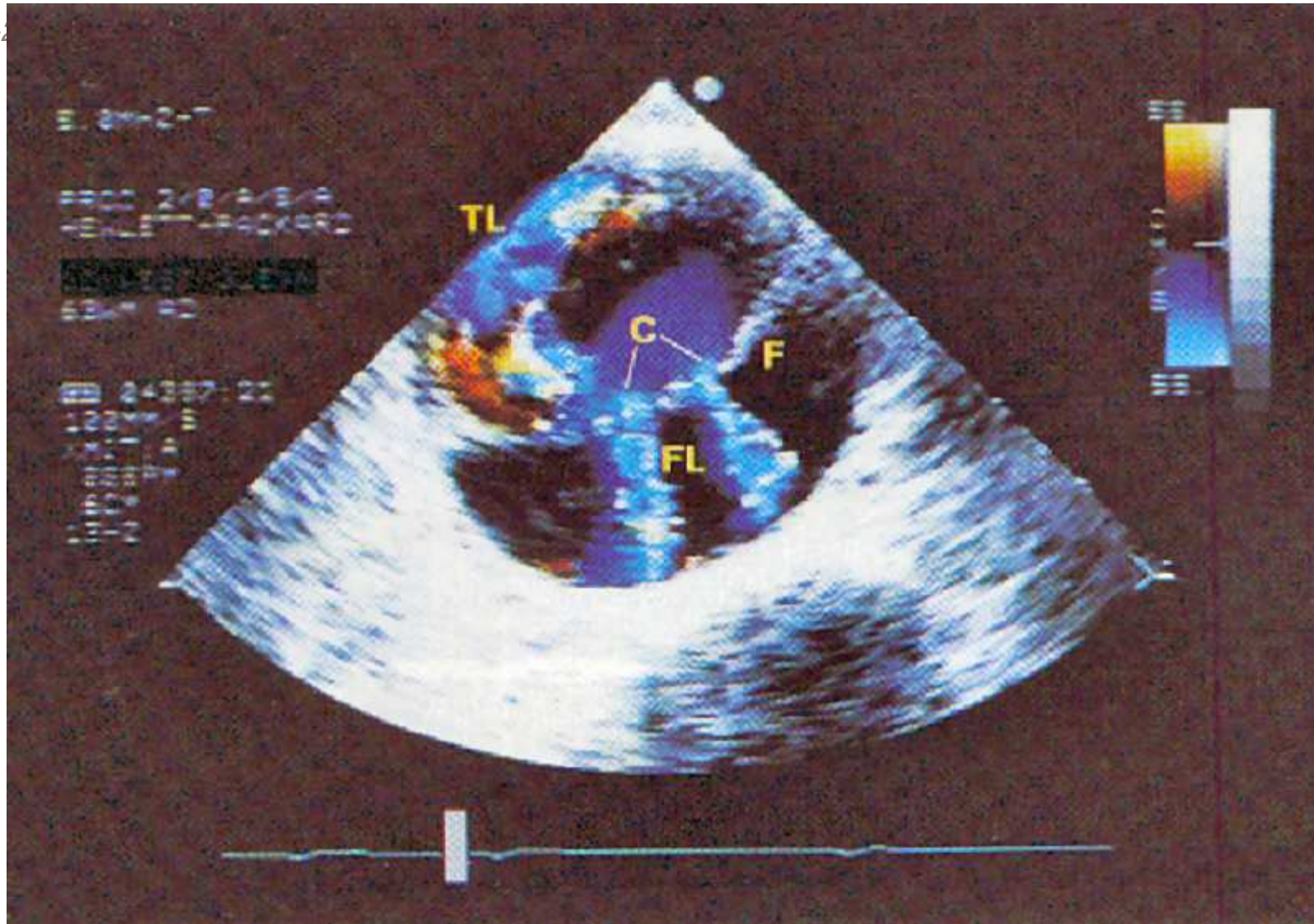
Dissection flap near Left Main ostium, but not involving it



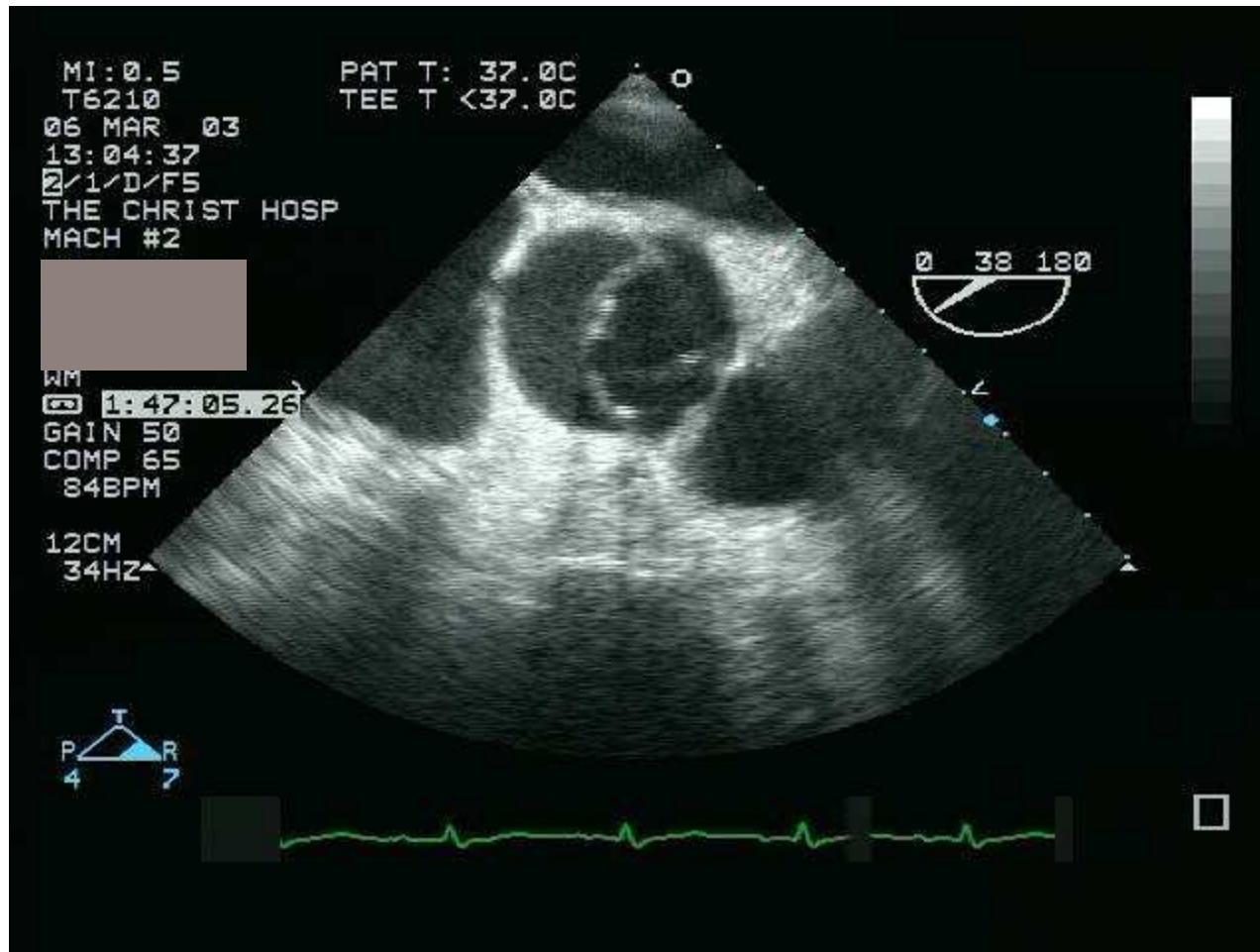
Dissection flap involving Right Main coronary artery



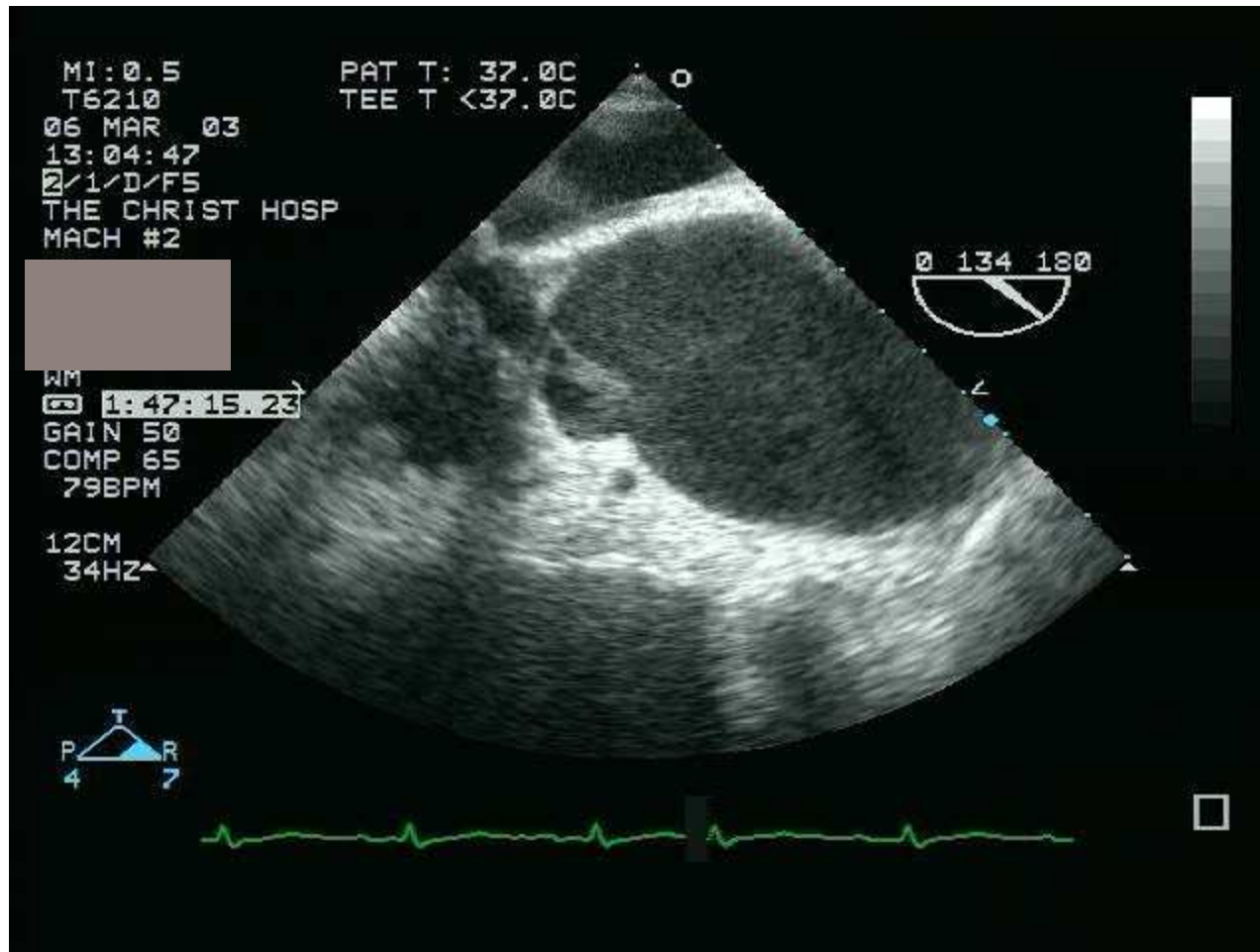
Communication between true and false lumen
Thrombus is false lumen



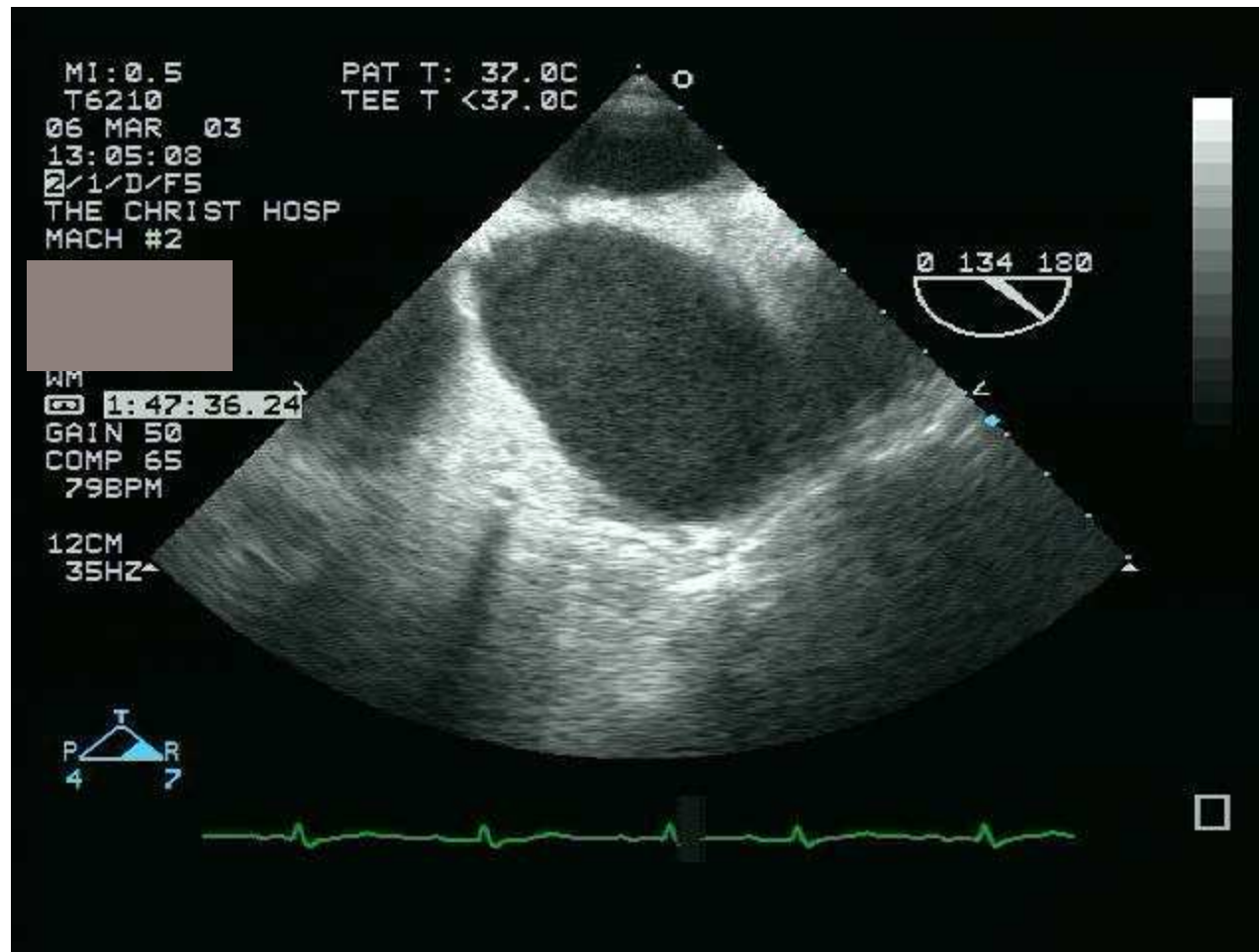
Color flow revealing two communications



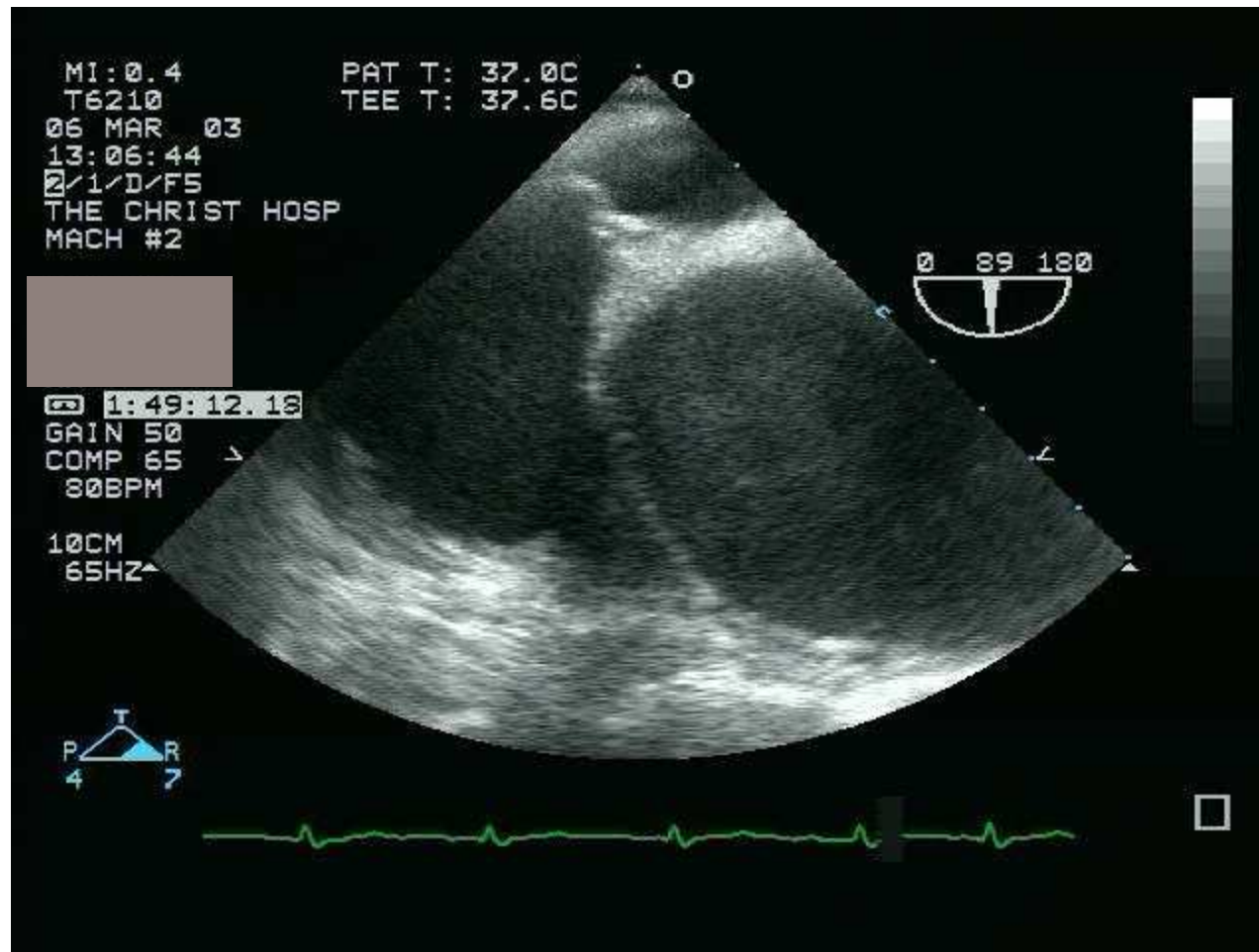
Short axis view of proximal dissection



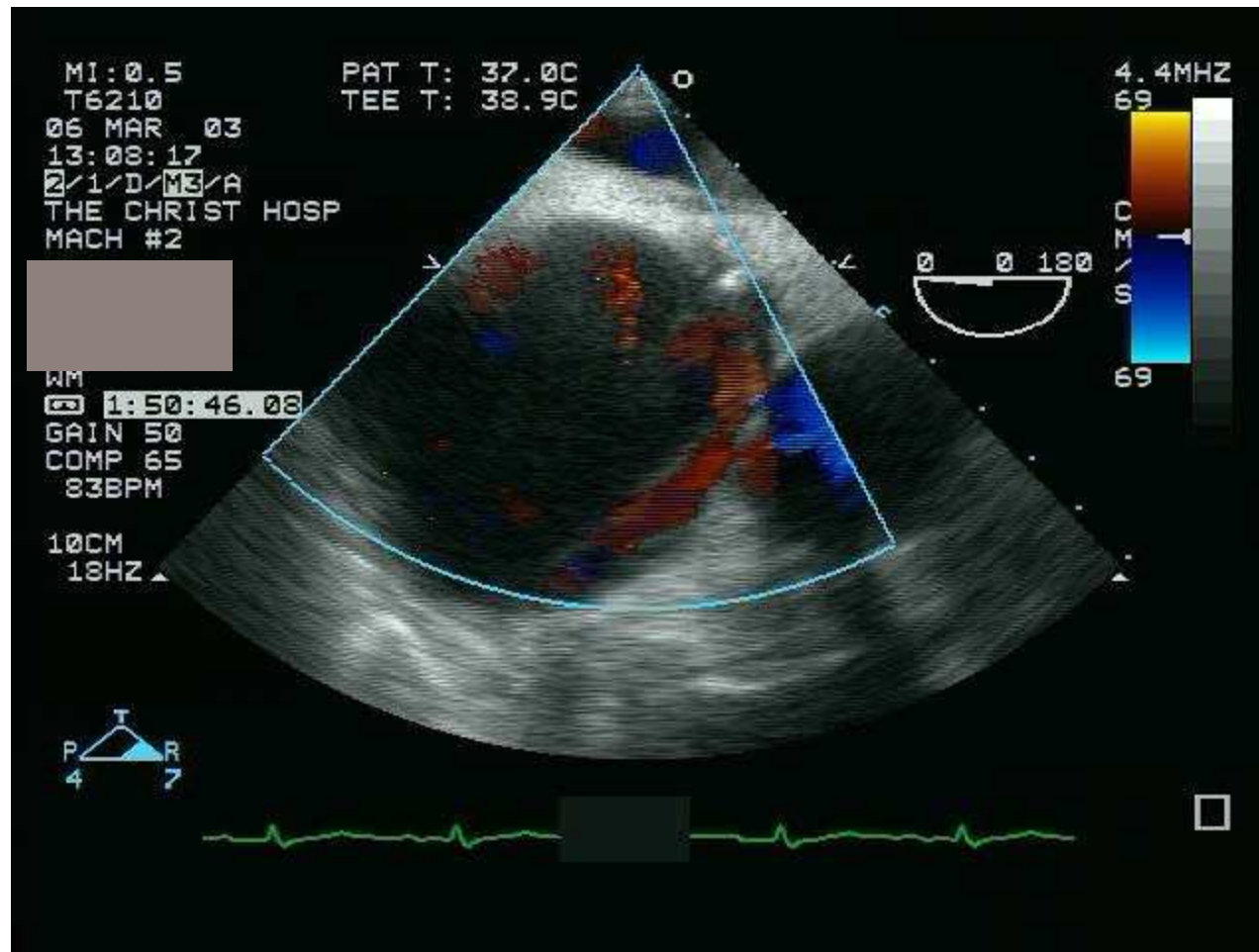
Long axis view of proximal dissection



Long axis view of proximal dissection panning to show intimal tear



Long axis view of proximal dissection, detail of intimal tear



Short axis view of proximal dissection, doppler over flap

Coronary angiography

- Acute involvement secondary to dissection
 - TEE able to verify patency in most cases
 - Proximal obstruction often can be identified intraoperatively
 - Catheterization may be unsuccessful and delay therapy
- Chronic atherosclerosis
 - CAD occurs in 25% of patients with dissection
 - Not typically identified intraoperatively
 - Small studies do not demonstrate much difference among
 - Patients with CAD vs those without
 - Patients with pre-op catheterization vs those without
 - Possible indication for catheterization

Medical Management

General Principles

- Acute care setting
- Two large bore IV catheters
- Arterial line, preferably in right arm
- Consider pulmonary artery catheter
 - CVP, CO, PCWP
- Try to spare femoral sites in preparation for bypass

Blood Pressure

- Goal is to lower dP/dt (force of LV ejection)
- IV Beta blockers
 - Propranolol, labetalol, esmolol
- Nitroprusside – potent vasodilator
 - When used alone, **increases dP/dt !**
- Contraindication to Beta blocker
 - Verapamil, diltiazem, nifedipine
- Consider ACE inhibitor if renal arteries compromised

Hypotension

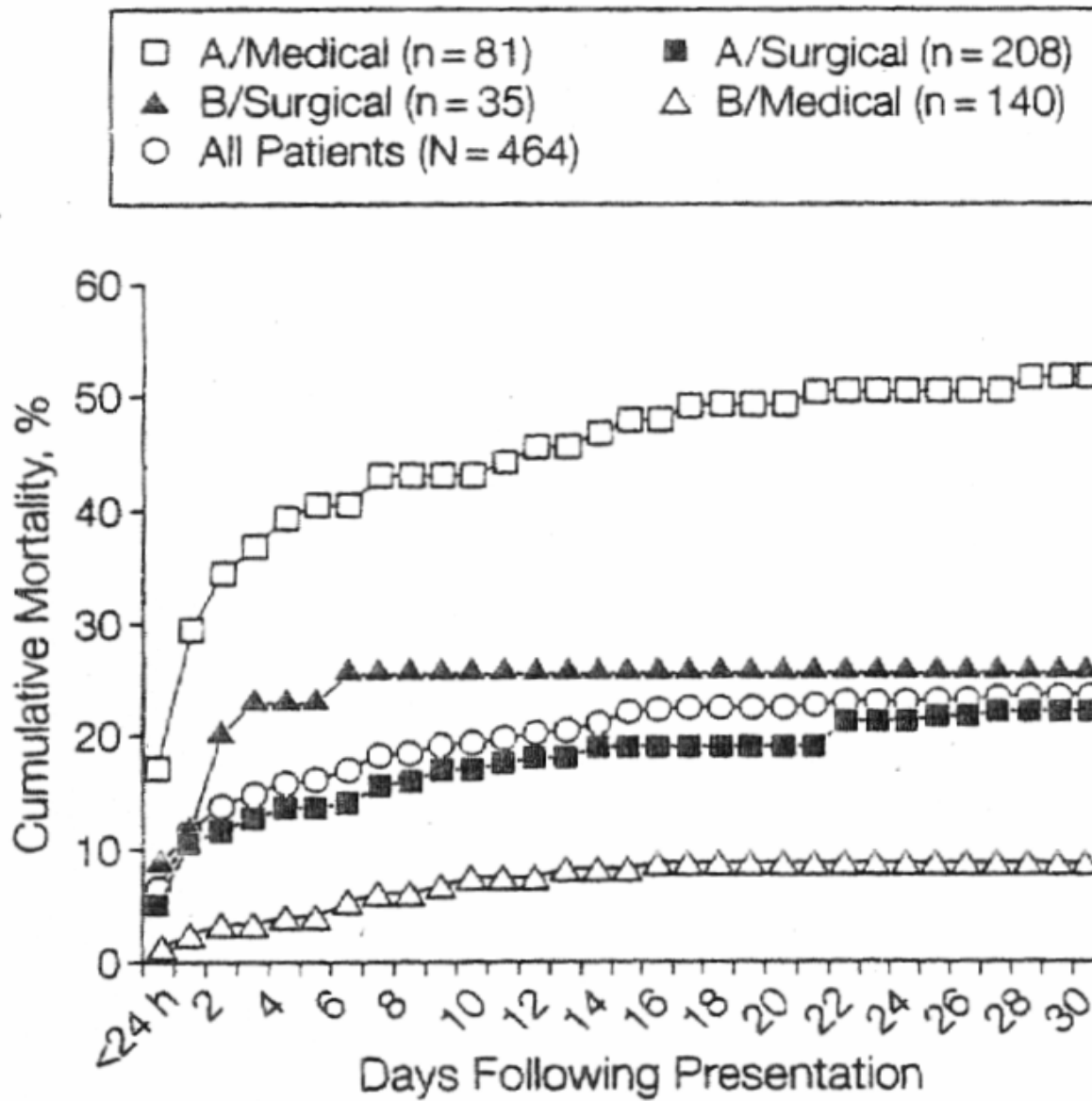
- Consider pseudohypotension
 - Involvement of brachiocephalic artery
- Consider tamponade, aortic rupture
- Rapid volume expansion
- Norepinephrine or phenlephrine if pressors are needed
 - Only low doses of dopamine, as this increases dP/dt

Tamponade

- Very small (7 patient) series have shown deleterious effect of pericardiocentesis
- Main goal is to proceed expeditiously to surgical repair
- Avoid pericardiocentesis unless PEA occurs

Definitive care

- Proximal dissection
 - Urgent surgical repair indicated
 - Medical treatment has 30 day survival up to 42%
- Distal dissection
 - Medical therapy equivalent to surgical repair when uncomplicated
 - 30 day survival of 92% with medical treatment
- Chronic dissection – medical therapy is preferred



Long term followup

- If discharged from hospital, 75-82% five year survival for all dissections
- Goal SBP <130 mmHg
 - Prefer long term Beta blocker
 - Avoid vasodilators alone
- 17-25% incidence of remote site aneurysm
 - Most appear within 2 year
 - Re-evaluate with MRI, CT, or TEE
 - 3,6,12,18,24 months then q6-12 months

Atypical aortic dissections

- Intramural hematoma
 - Rupture of vasa vasorum in medial layer
 - No intimal tear
 - Best identified with CT with & without contrast
 - May use MRI or TEE although not as sensitive
 - Same management as typical dissection
- Penetrating atherosclerotic ulcer
 - Ulceration of pre-existing atherosclerotic lesion
 - Best seen with aortography
 - Typically localized without spread
 - Further surgical indications:
 - Penetration through medial layer to cause pseudoaneurysm
 - Penetration through adventitia to cause rupture

References

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