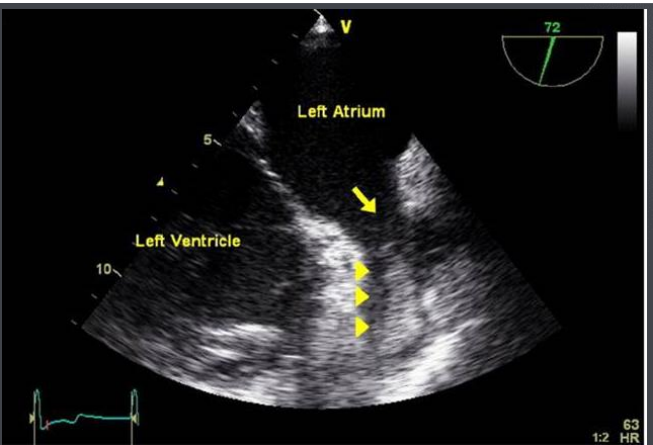
What Evil Lurks in the Hearts of Men?

Neal S. Gaither, MD, FACC, FSCAI



The Sonographer Knows…

Definition of Stroke

"sudden death of brain cells in a localized area due to inadequate blood flow"

- Annually, 500,000 new cases in U.S.
  - one in three events is fatal
- Third leading cause of death
- Leading cause of disability
  - 3 Million Americans currently permanently disabled

Overview of Stroke

- Hemorrhagic stroke:
  - Intracerebral hemorrhage (Hypertension most common cause)
  - Subarachnoid hemorrhage
- Ischemic stroke (can undergo hemorrhagic conversion):
  - Atherothrombotic infarct – local occlusion of an artery
  - Embolic infarct –
    - Material causing infarct travels from elsewhere
  - Hypoperfusion – global decrease in brain blood flow

- Hemor
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- Lacunar stroke – "empty space"
  - Small infarcts in deep brain structures due to occlusion of a deep penetrating artery
  - Less closely associated with cardiac sources of embolism

Stroke type	Clinical course	Risk factors	Other clues
Intracerebral Hemorrhage	Gradual progression during minutes or hours	Hypertension Trauma Bleeding diatheses Illicit drugs (cocaine) Vascular malformations Blacks and Asians	Precipitated by sex or other physical activity. Patient may have reduced alertness.
Subarachnoid Hemorrhage	Sudden, severe headache Focal brain dysfunction less common than with other types.	Smoking, hypertension, alcohol , genetic susceptibility (eg, polycystic kidney disease, family history) Drugs (cocaine)	Precipitated by sex or other physical activity. Patient may have reduced alertness
Ischemic (thrombotic)	Stuttering progression with periods of improvement	Atherosclerotic risk factors (age, smoking, diabetes mellitus, etc.). Men >> women	History of TIA Neck bruit
Ischemic (embolic)	Sudden onset with deficit maximal at onset. Clinical findings may improve quickly.	Atherosclerotic risk factors Men >> women Heart disease (valvular, atrial fibrillation, endocarditis)	Can be precipitated by getting up at night to urinate, or sudden coughing or sneezing.

Causes of Ischemic Stroke

- 50% - Cerebral /cervical vasculature
- 20% - High-risk cardiac abnormalities
- 30% - "Cryptogenic"
  (many have embolic features suggesting a possible cardioaortic origin)

Computed tomography scan in a patient with atrial fibrillation, showing a hyperdensity in the right middle cerebral artery consistent with thromboembolism (arrow). Figure illustrations by Rob Flewell

J Am Coll Cardiol 2008; 51:1049–59

Characteristics of Cardioembolic Stroke

- 14-30% of all strokes
  - Increases with age
- Cardiac emboli are often large
  - Larger strokes
  - High incidence of morbidity and mortality compared with other types of stroke
- Recurrent events are common but *may be prevented* with appropriate recognition and treatment

Characteristics of Cardioembolic Stroke

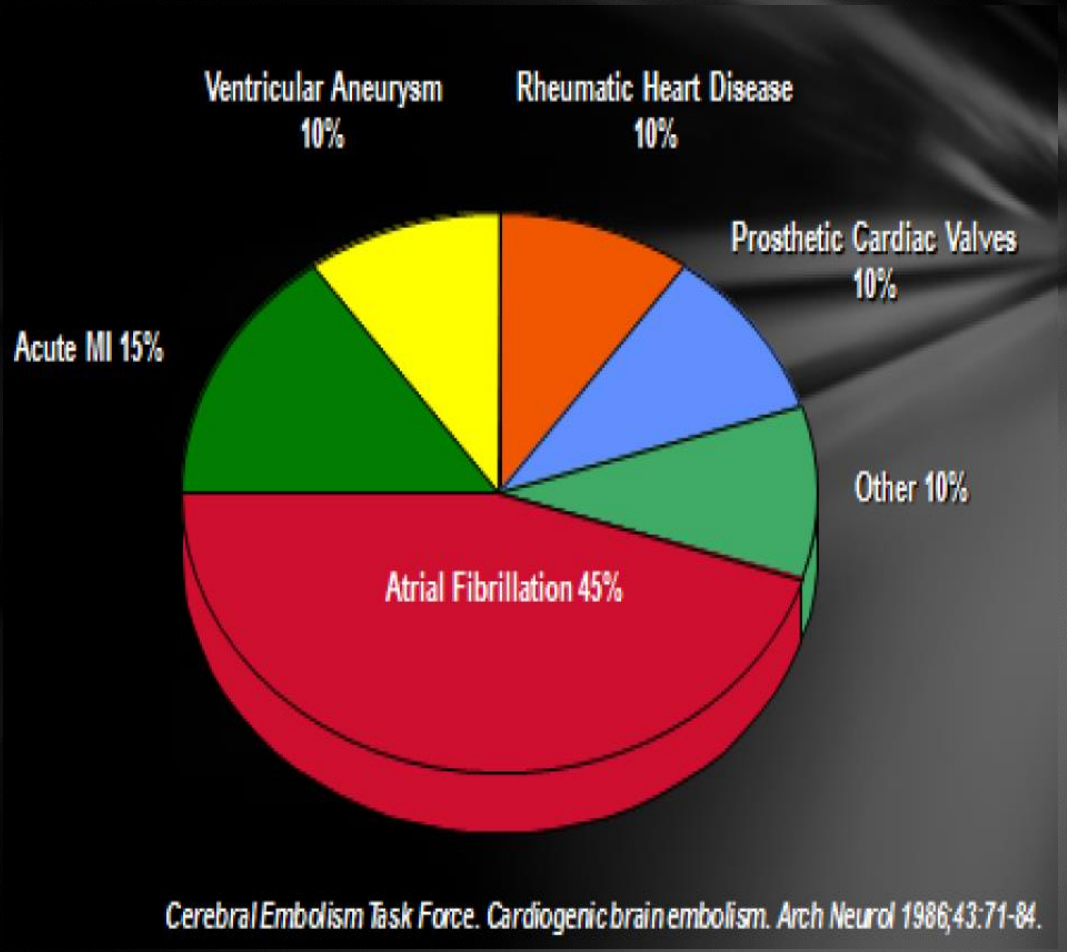
- Clinical diagnosis
  - No gold standard
  - Potential cardiac source coupled with absence of other obvious cause
- Neuroimaging findings suggestive of cardioembolic stroke:
  - Simultaneous/sequential strokes in different territories
  - Predominate in carotid and middle cerebral artery territories
  - Hemorrhagic transformation may be more common

Characteristics of Cardioembolic Stroke

- How does this happen?
  - Blood stasis in a left-sided cardiac chamber
  - Release of material from an abnormal structure
  - Abnormal passage from venous to arterial circulation (paradoxical embolism)

Cardiac source of embolism

- Atrial fibrillation
- Ischemic Heart Disease
  - Recent Myocardial infarction
  - Ischemic cardiomyopathy/LV aneurysm
- Paradoxical Emboli
- Valvular Heart Disease
  - Mechanical prosthetic valve
  - Rheumatic mitral stenosis
  - Endocarditis
- Dilated cardiomyopathy
- Cardiac tumors



Cardiac Sources of Embolism

High Risk

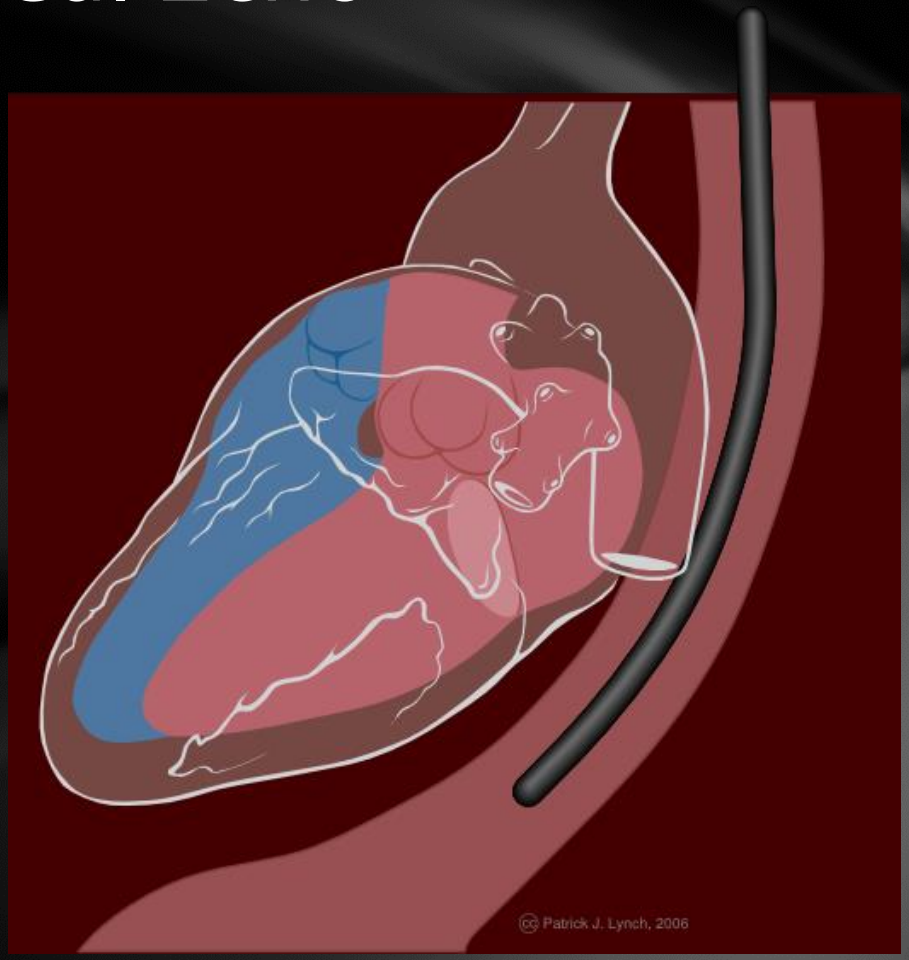
- Atrial arrhythmias
- Left atrial thrombus
- Left ventricular thrombus
- Primary cardiac tumors
- Metastatic cardiac tumors
- Cardiac vegetations
- Prosthetic cardiac valve
- Aortic atheroma

Intermediate or Uncertain Risk

- Interatrial septal abnormalities
  - Patent foramen ovale, ASD
  - Atrial septal aneurysm
  - Septal pouch
- Pulmonary arteriovenous malformation
- Spontaneous echo contrast "smoke"
- Mitral valve prolapse
- Valvular calcification
- Valvular strands

Transesophageal Echo

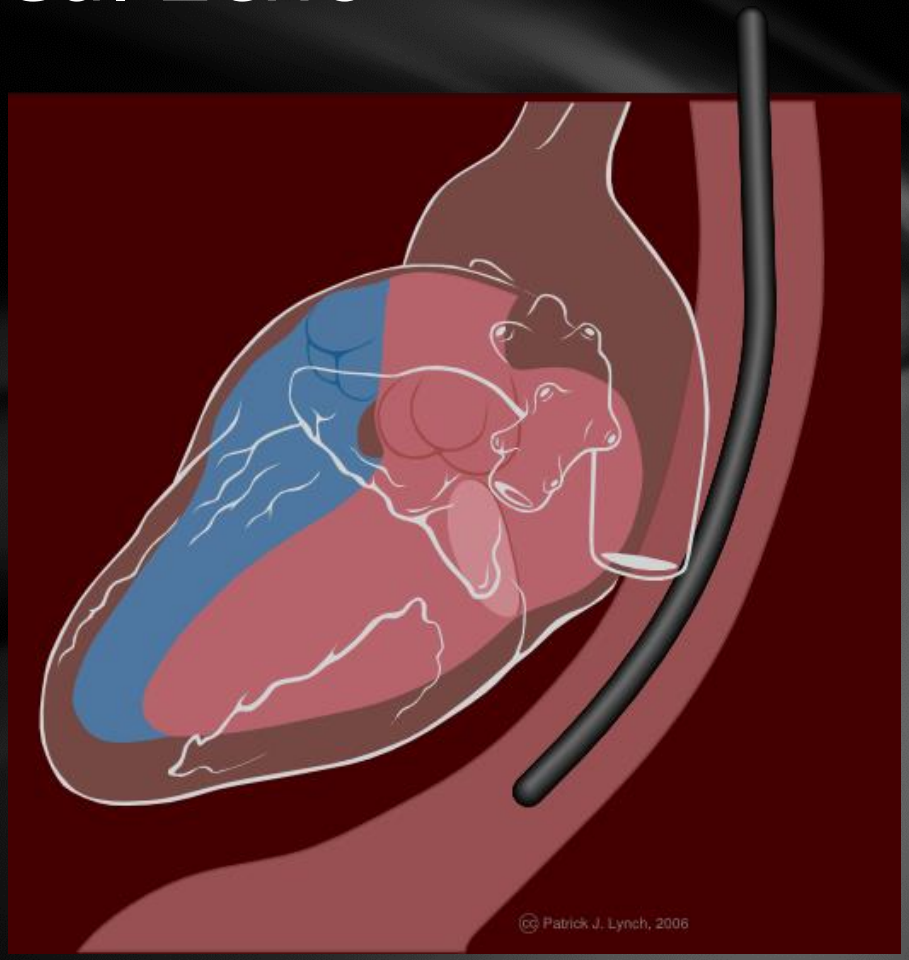
- **More sensitive for detecting intracardiac source of embolism:**
  - **57% vs. 15% by TTE****
- **More likely to be helpful**
  - Younger patients with stroke
  - Non-lacunar stroke
- **Weaknesses:**
  - LV apex



** Pearson, et. al. JACC 1991; 17(1):66.

Transesophageal Echo

- **Higher sensitivity for:**
  - Left atrial thrombus
  - Abnormal prosthetic valve (esp. Mitral)
  - Aortic arch atheroma
  - Patent Foramen Ovale (PFO)
  - Spontaneous Echo Contrast ("smoke")
  - Valvular strands



** Pearson, et. al. JACC 1991; 17(1):66.

Distribution of Cerebral Infarctions According to Age in the Sagrat Cor Hospital of Barcelona Stroke Registry

Subtype of Cerebral Infarction (n = 1840)	Years of Age			
	< 65 (n= 314)	65–74 (n=501)	75–84 (n=722)	≥ 85 (n=303)
Cardioembolic	46 (14.6)	100 (20)	213 (29.5)	109 (36)
Atherothrombotic	66 (21.0)	159 (31.7)	233 (32.3)	95 (31.4)
Lacunar	93 (29.6)	159 (31.7)	173 (24)	59 (19.5)
Unknown cause	61 (19.4)	69 (13.8)	81 (11.2)	37 (12.2)
Unusual cause	48 (15.3)	14 (2.8)	22 (3.0)	3 (1)

Cardiac Disorders Associated with Cardioembolic Stroke in 402 Patients

Cardiac source of Embolism	Patients
Atrial Fibrillation without structural heart disease	89 (22.1%)
Isolated Structural Heart Disease	81 (20.1%)
Atrial Fibrillation Complicating Structural Heart Disease	232 (57.7%)

402 Patients in the Barcelona Stroke Registry

Cardiac Source of Embolism	Total Patients	
Atrial fibrillation	318 (79.1%)	
Lone atrial fibrillation		88
Associated with structural cardiac disease		230
Hypertensive left ventricular hypertrophy	120 (29.8%)	
Associated with atrial fibrillation		118
Associated with atrial flutter		2
Left ventricular systolic dysfunction	91 (22.6%)	
Sinus rhythm		59
Atrial fibrillation		32
Rheumatic mitral valve disease	50 (12.4%)	
Mitral annular calcification	40 (9.9%)	
Mitral valve prolapse	5 (1.2%)	
Atrial septal aneurysm with patent foramen ovale	4 (1%)	
Degenerative heart valve disease	4 (1%)	

Cardiogenic Stroke: Causes

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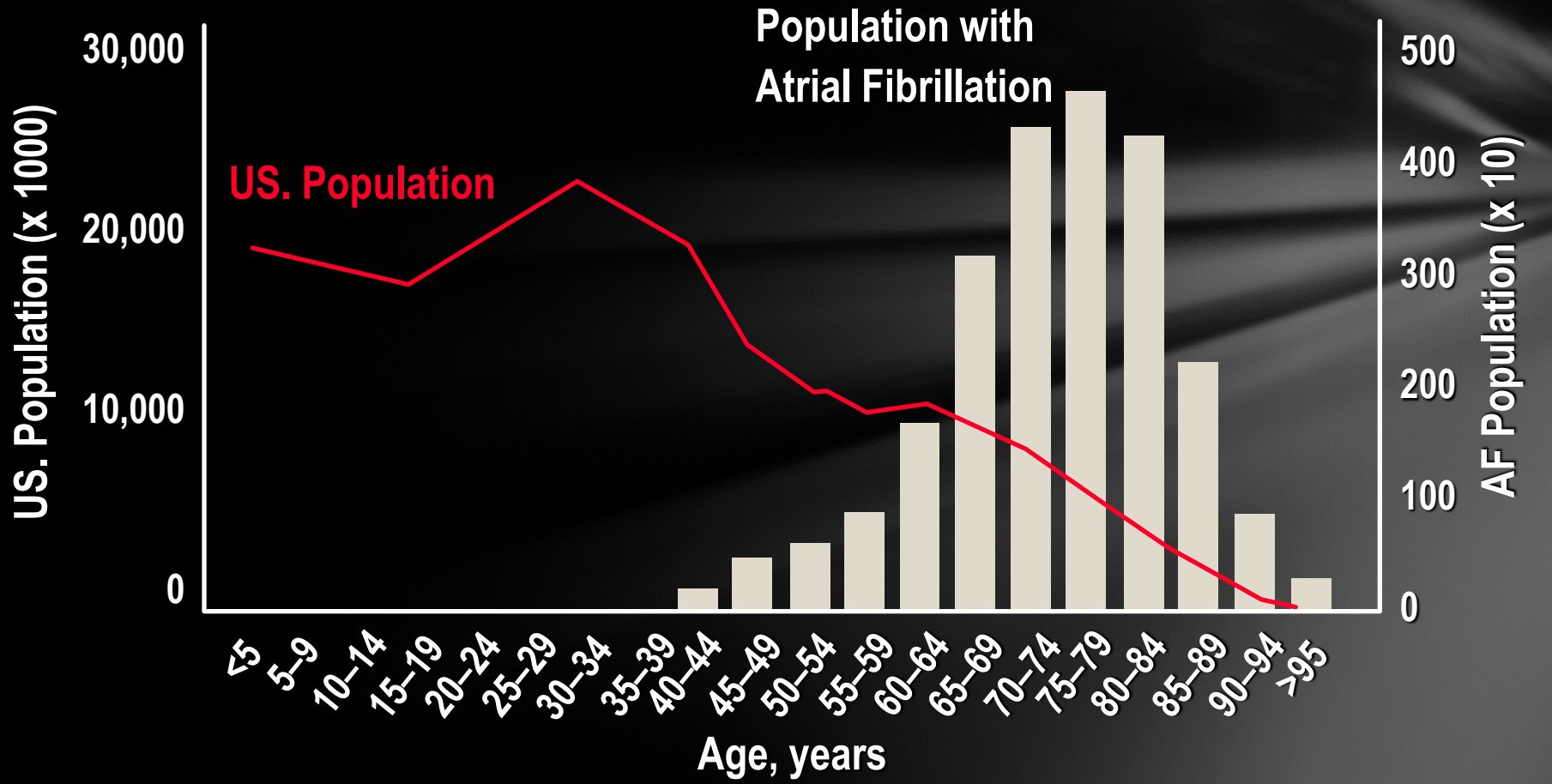
  - Ischemic cardiomyopathy/LV aneurysm
- Paradoxical Emboli
- Valvular Heart Disease
  - Mechanical prosthetic valve
  - Rheumatic mitral stenosis
  - Endocarditis
- Dilated cardiomyopathy
- Cardiac tumors

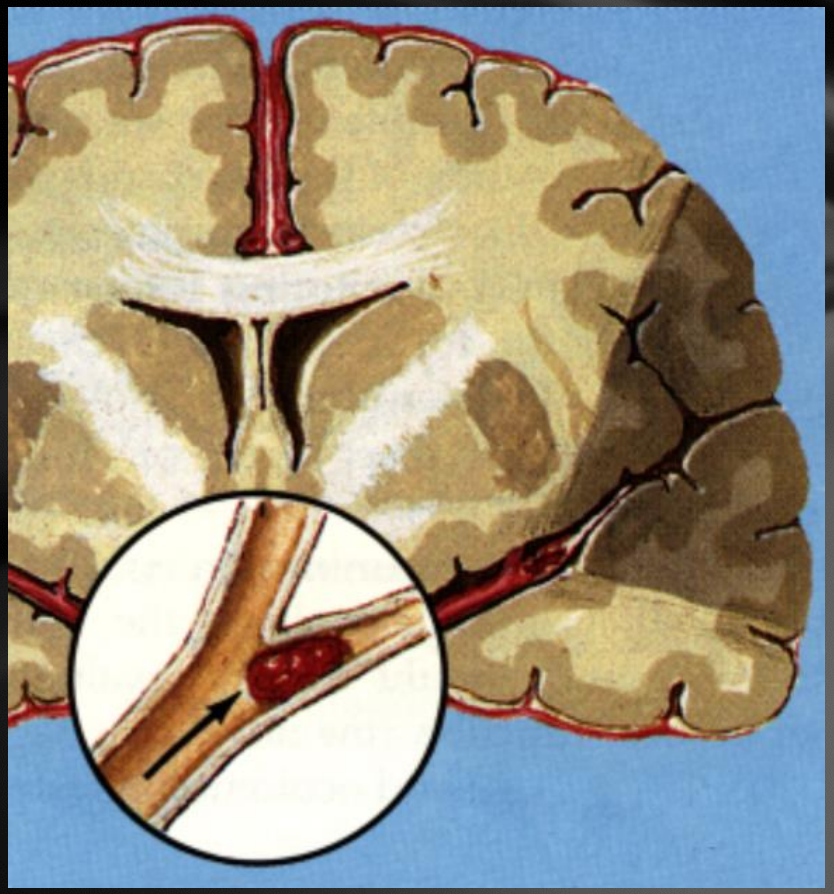
Age Distribution of People With AF Compared With US. General Population



Feinberg WM, et al. Prevalence, age distribution, and gender of patients with atrial fibrillation: analysis and implications. Arch Intern Med 1995;155:469-473.

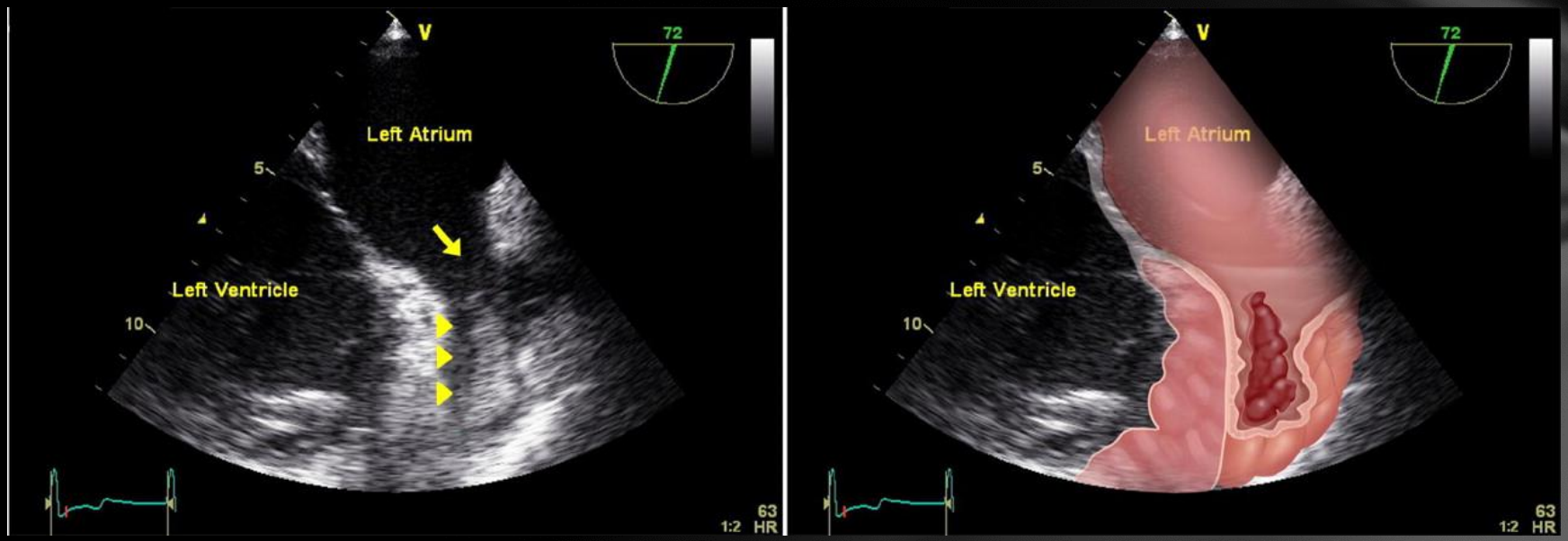
Atrial Fibrillation and Stroke

- Approximately 80,000 strokes per year are associated with AF
- Risk of stroke is 5% per year
- Atrial Remodeling in AF:
  - Electrical remodeling
  - Histologic remodeling
  - Anatomic remodeling - "Atrial Cardiomyopathy"
- 90% of Left Atrial Thrombi develop in the Left Atrial Appendage



Laupacis A, et al. Antithrombotic therapy in atrial fibrillation. Chest 1998;114(5):579S-589S.Agency for Health Care Policy and Research (AHCPR). Life-saving treatments to prevent stroke underused. Research Activities 1995;187:1-3.

TEE: LA Appendage Thrombus



Doufekias, E. et al. J Am Coll Cardiol 2008;51:1049-1059

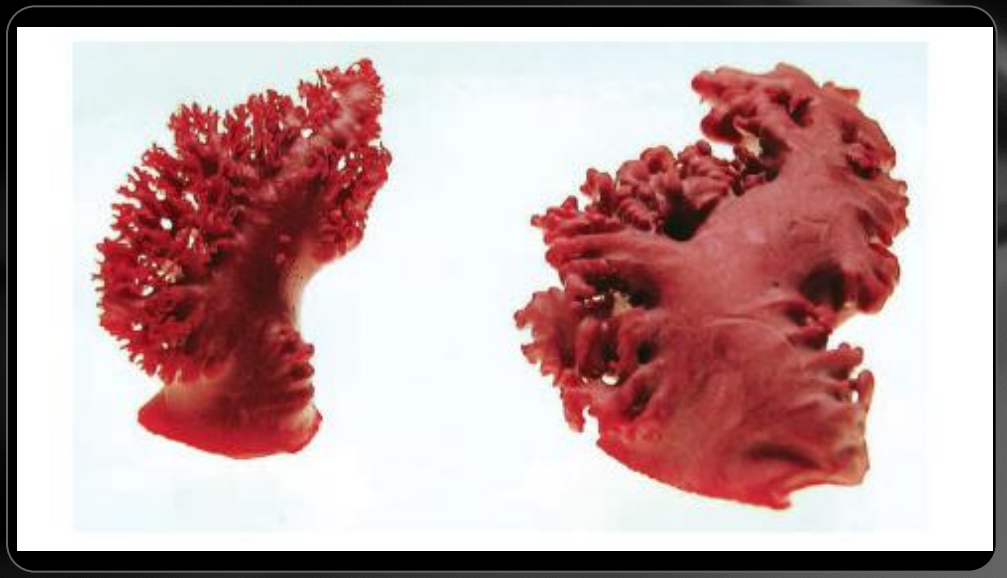
JACC Journal of the American College of Cardiology

A Look Inside the Appendage

Left Atrial Appendage: Normal rhythm Vs. Chronic AF

Left: Cast from a 52-year-old man with antemortem sinus rhythm. Volume is 5.88 cm^2. Cast has 20 to 40 twigs and is densely covered with fine structures.

Right: Cast from a 76-year-old man with antemortem AF. Volume is 18.67 cm^2. Cast has more than 40 twigs and no fine structures.



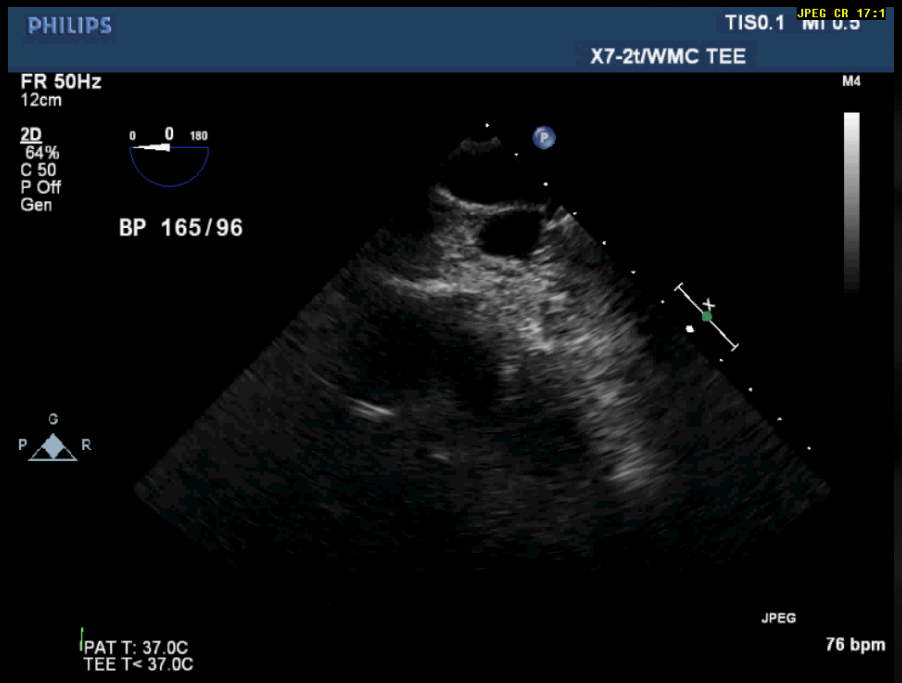
- LAA area >6 cm^2 clear risk factor for arterial emboli in the SPAF-II study
- Patients may have LAA surgically ligated during valve surgery to prevent cardioemboli
- Percutaneous LAA occlusion device available for patients in whom anticoagulation may be contraindicated

SPAF = Stroke Prevention in Atrial Fibrillation.

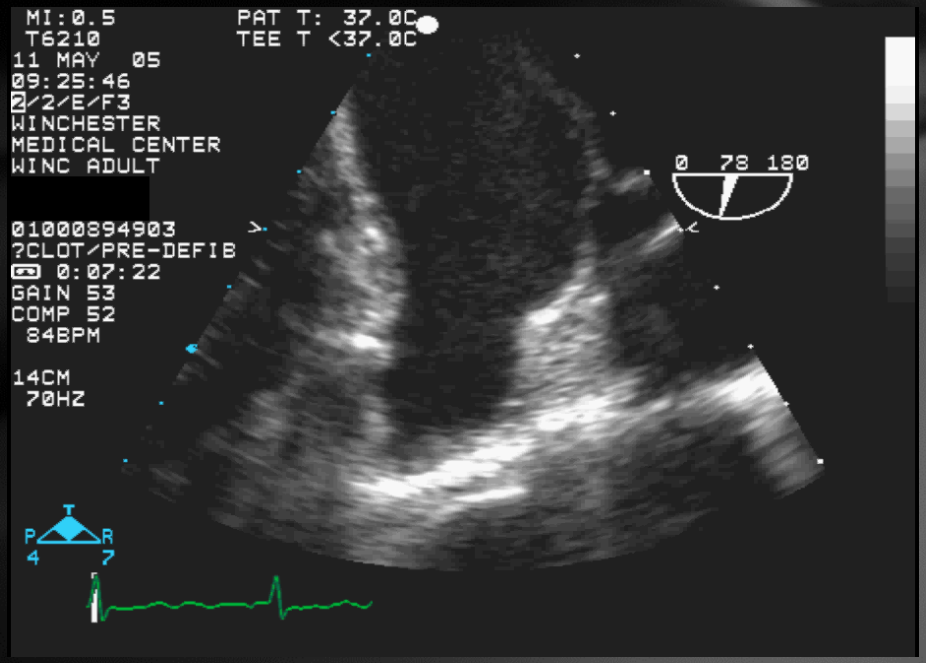
Adapted from Stöllberger C, et al. *Chest.* 2003;124:2356-2362.

Atrial Remodeling: "Atrial Cardiomyopathy"

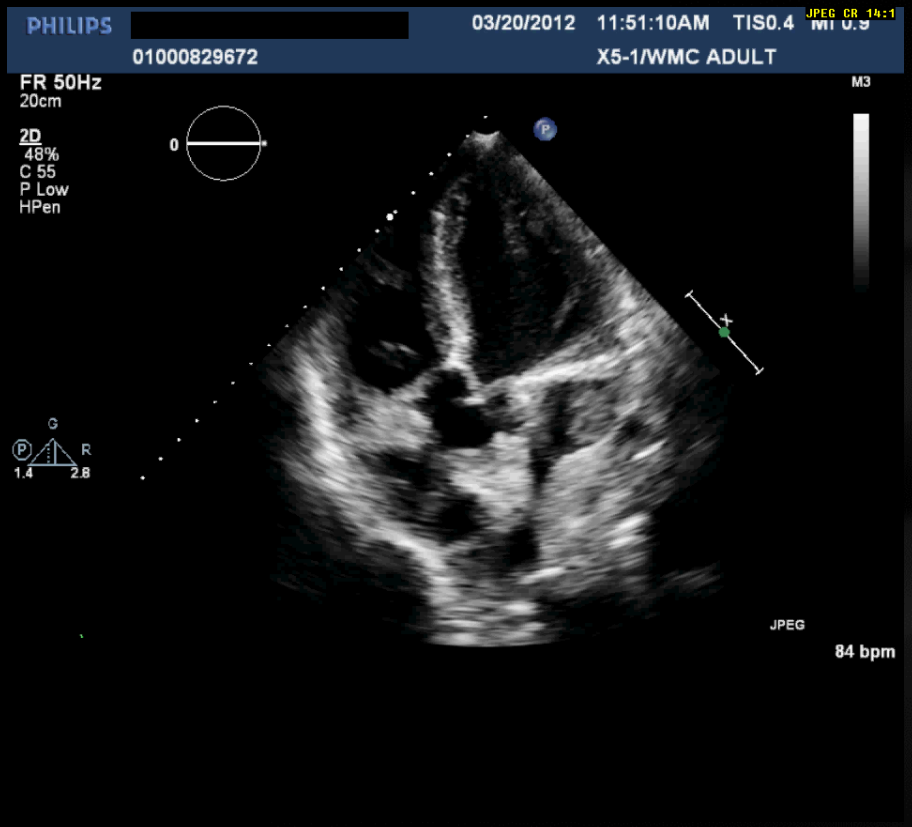
Normal LA Appendage

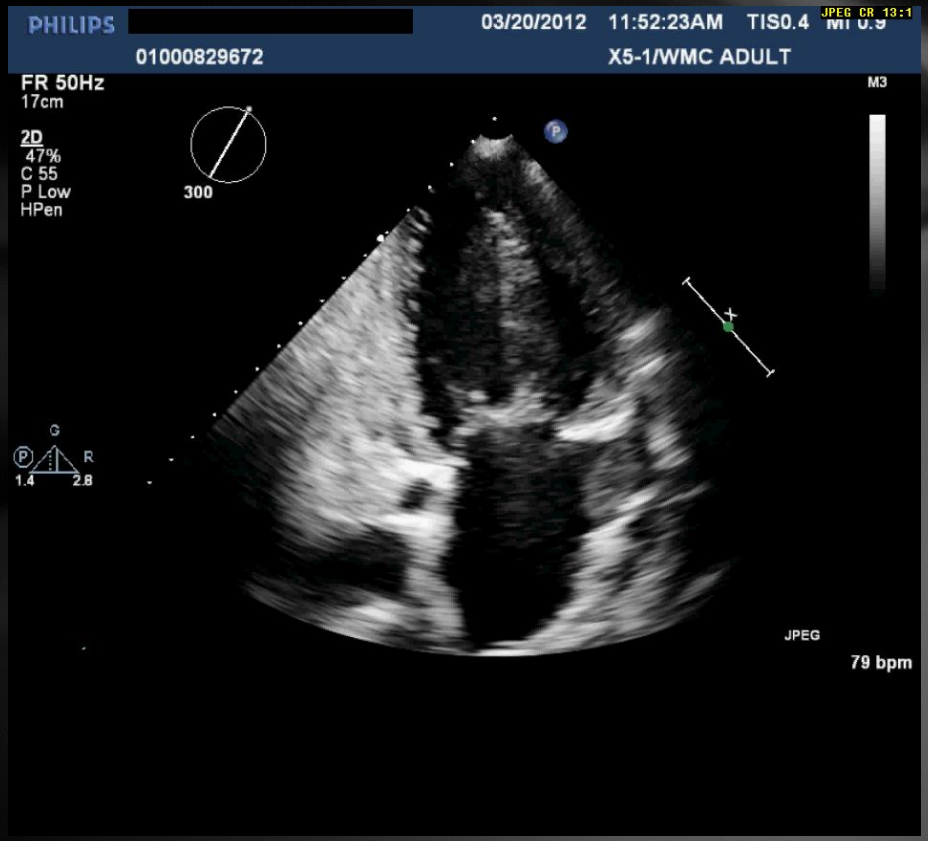


LA Appendage in AF

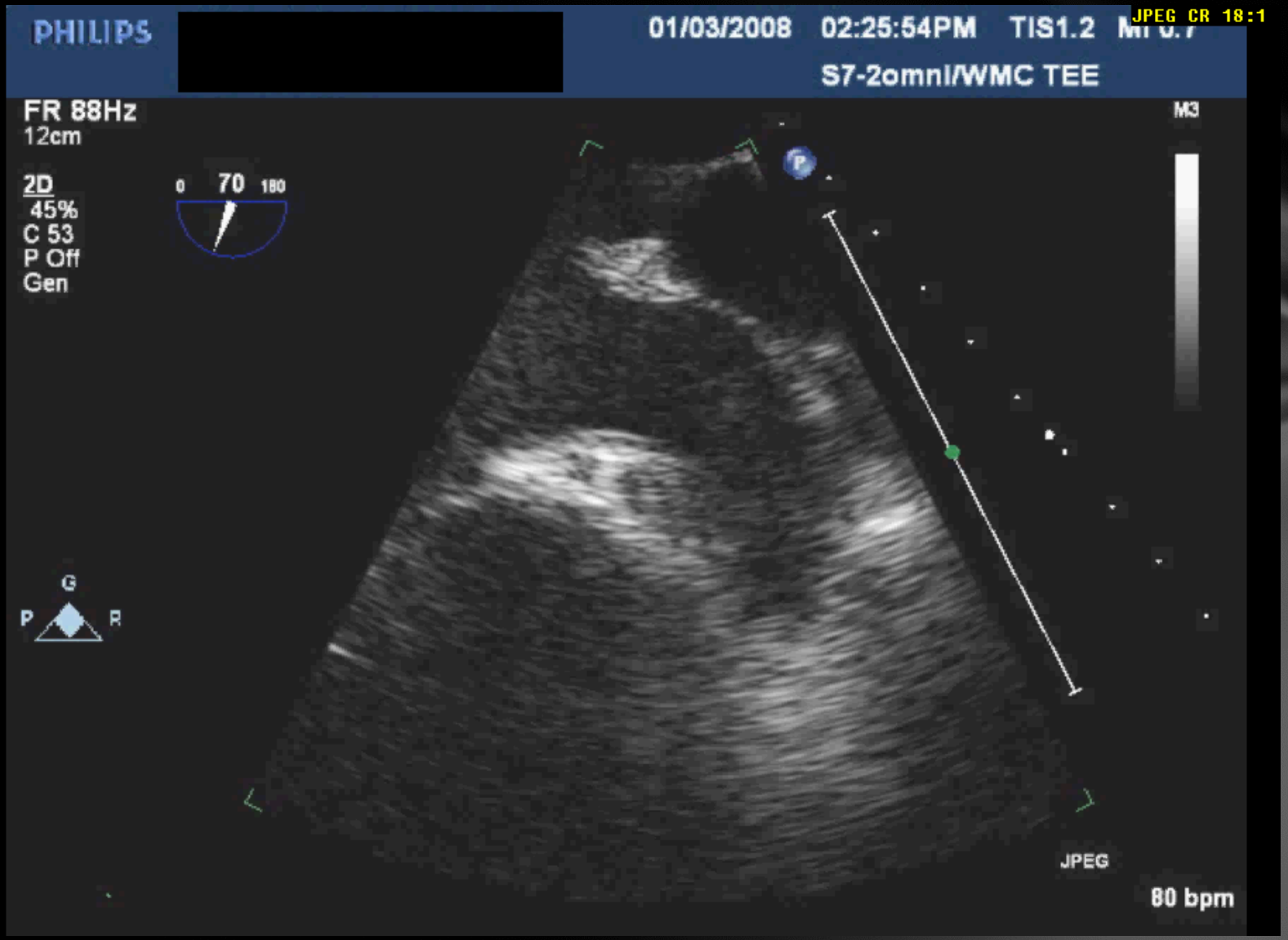


Dilated Cardiomyopathy





Left Atrial Appendage Thrombus seen with TTE (rare)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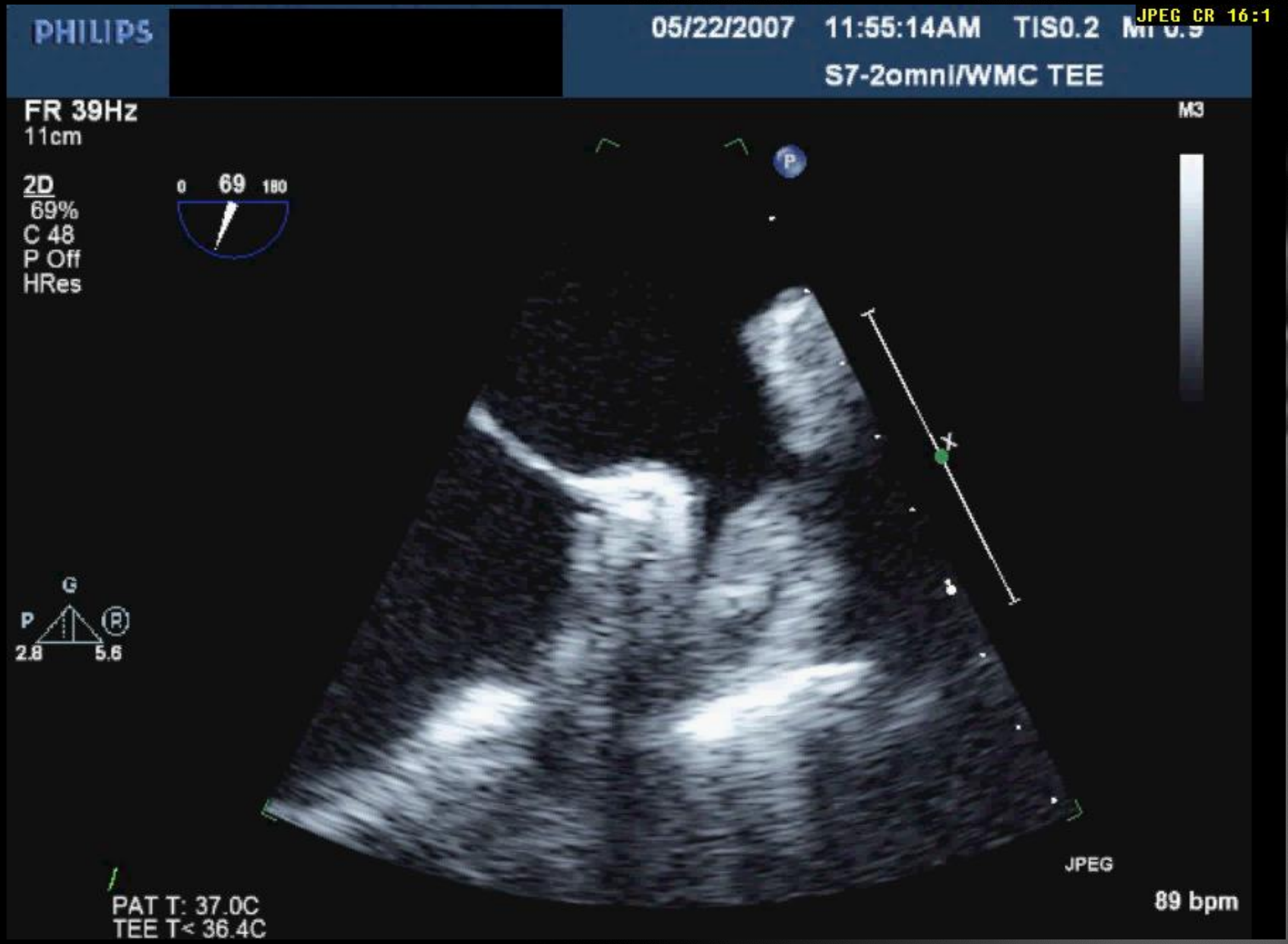
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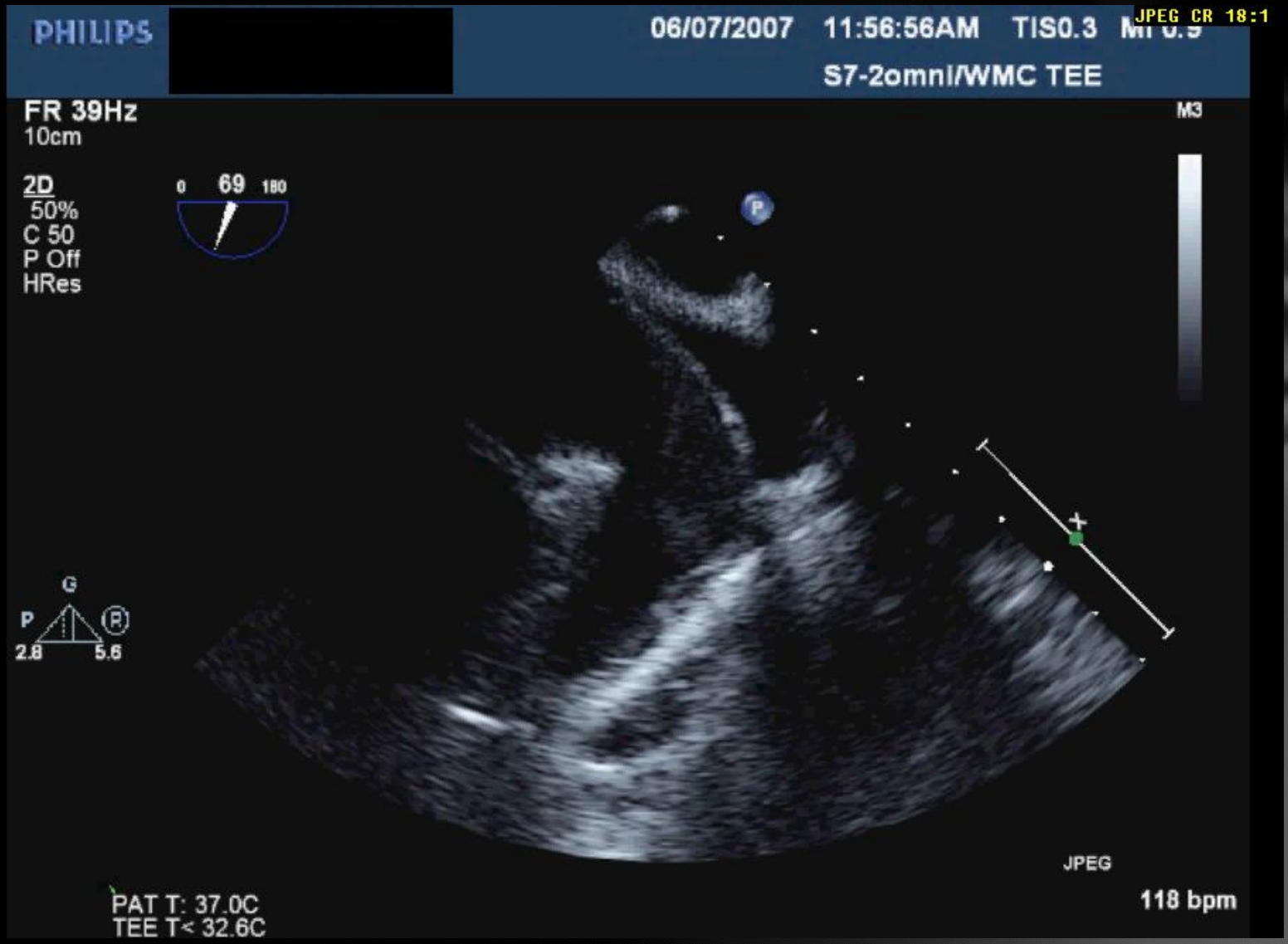
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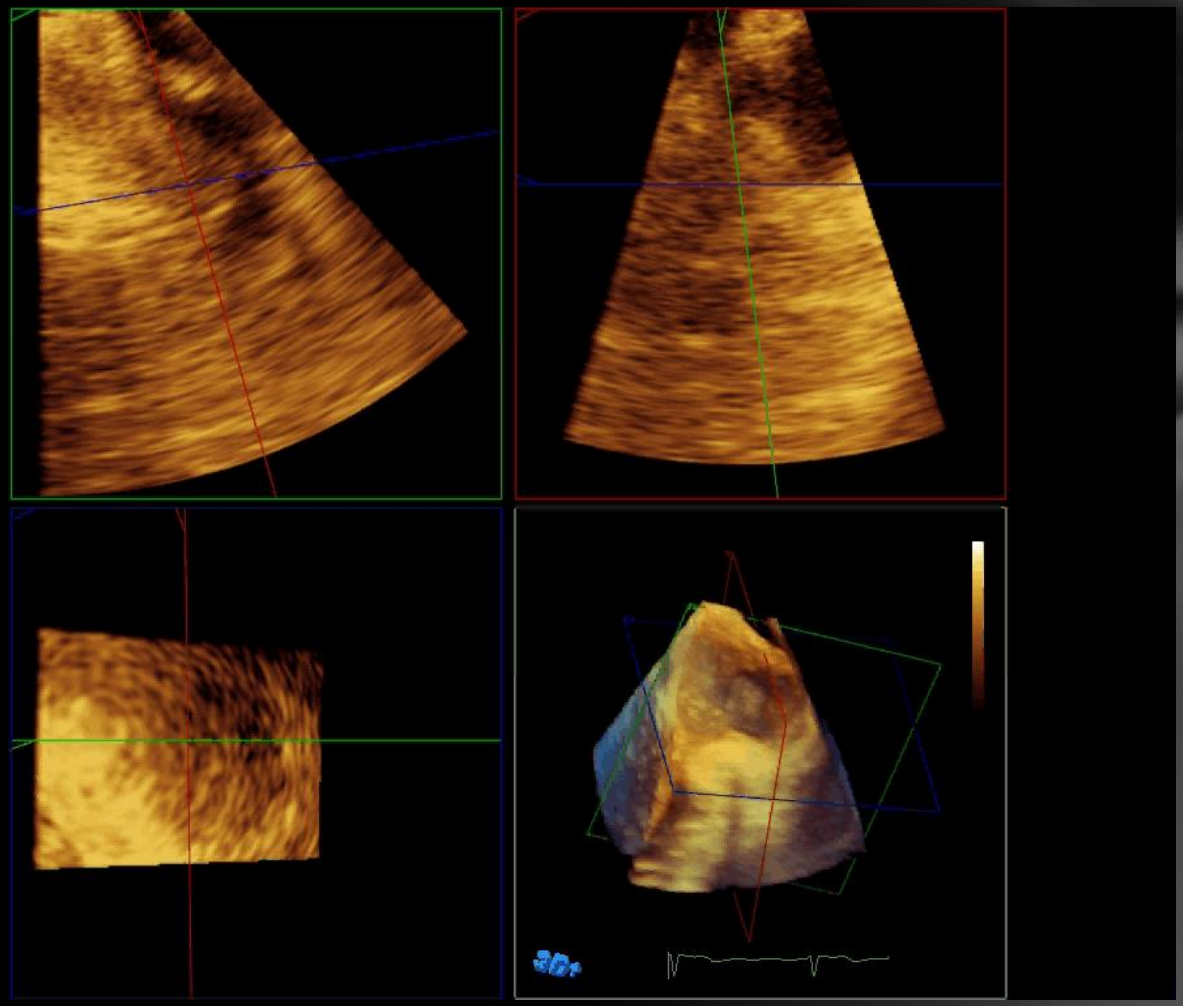
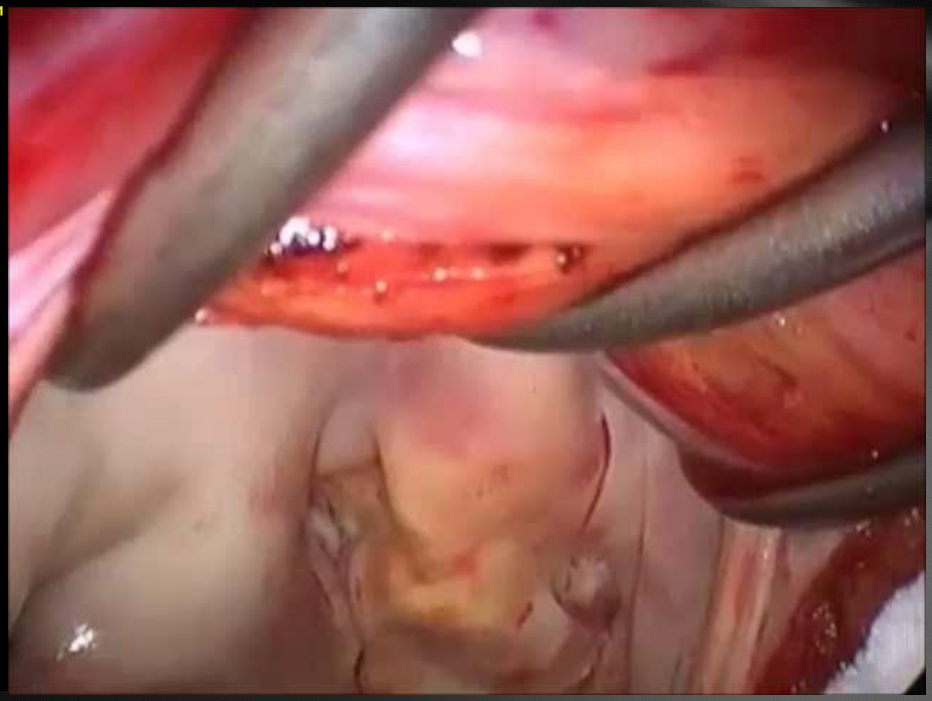
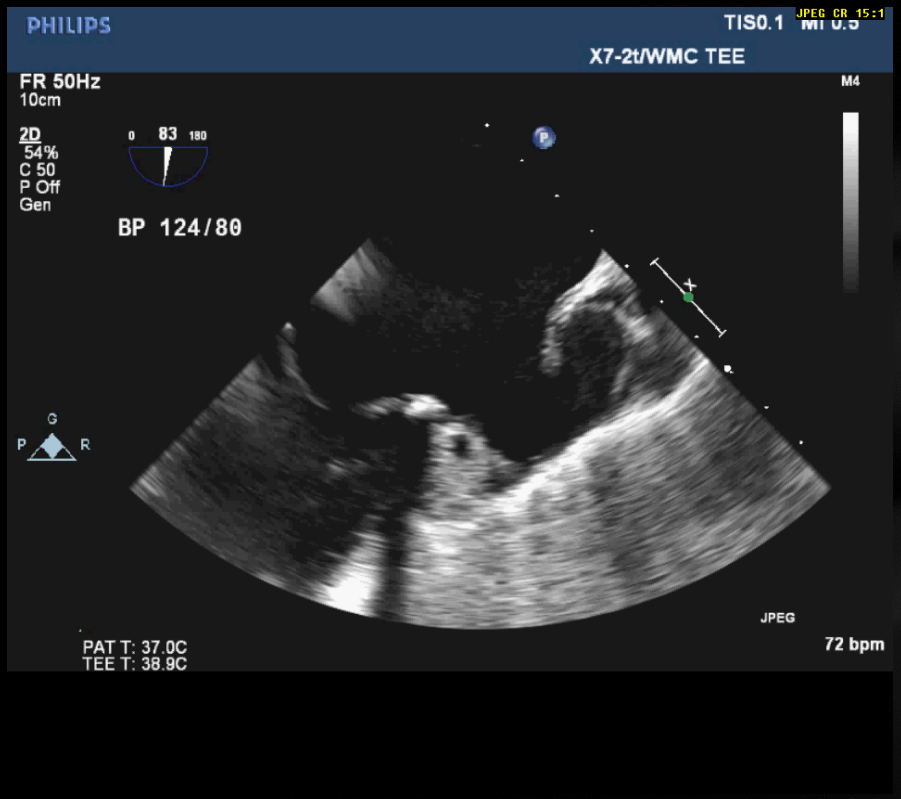
3-D Left Atrial Appendage Thrombus

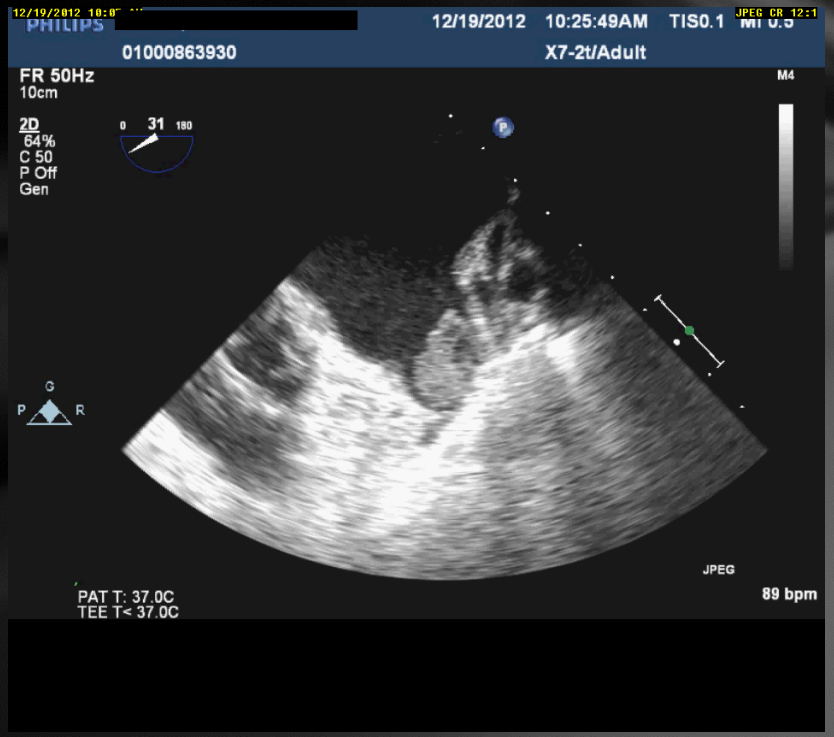


Left Atrial Appendage Thrombi – not always evident!

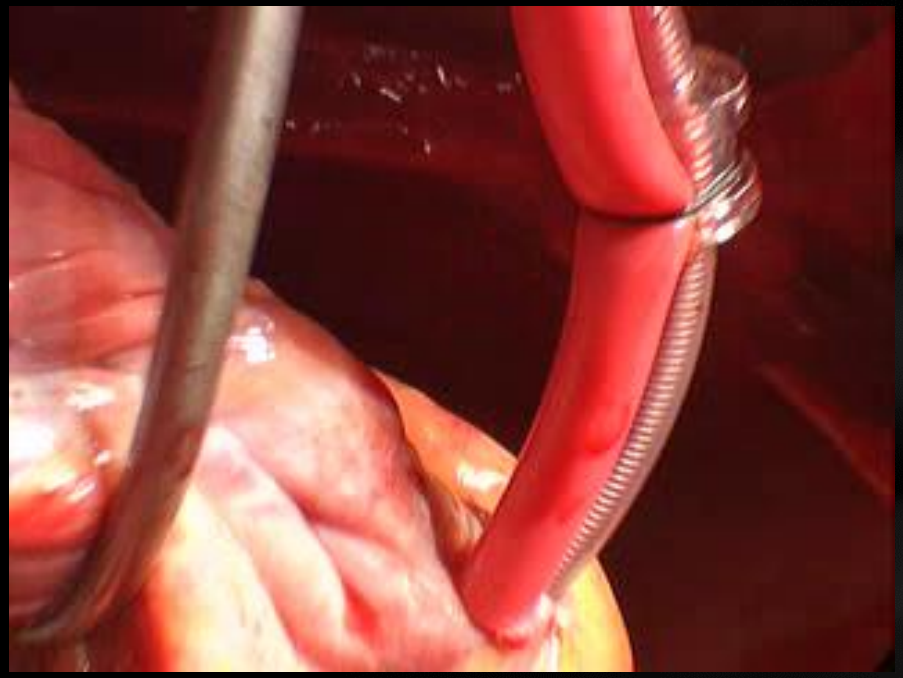


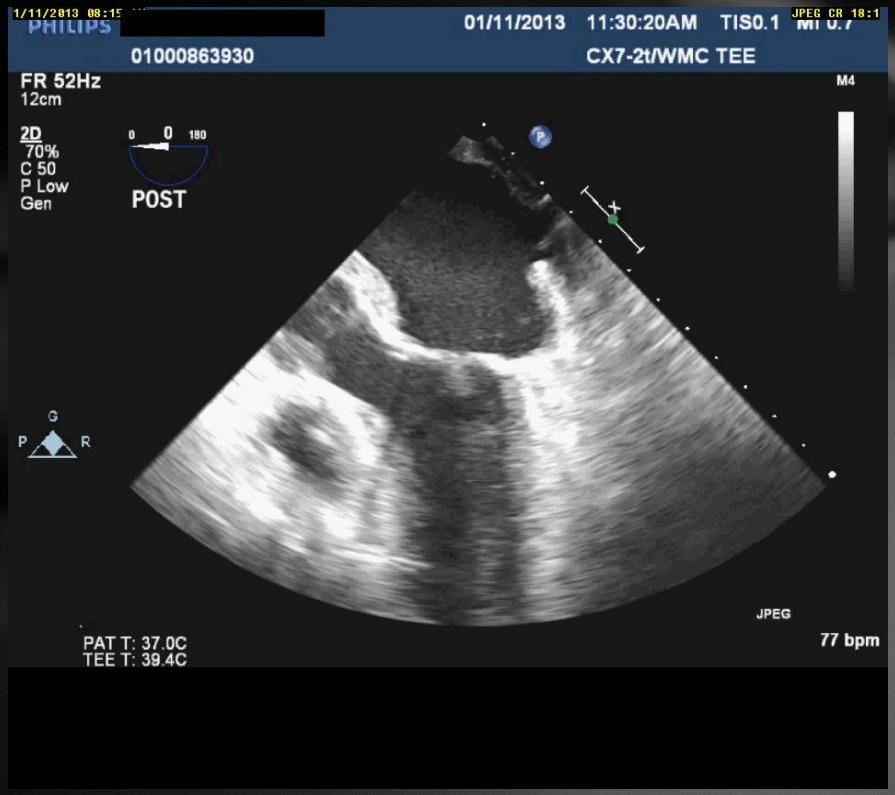
A Tale of Two Thrombi





LAA Closure: Postop TEE





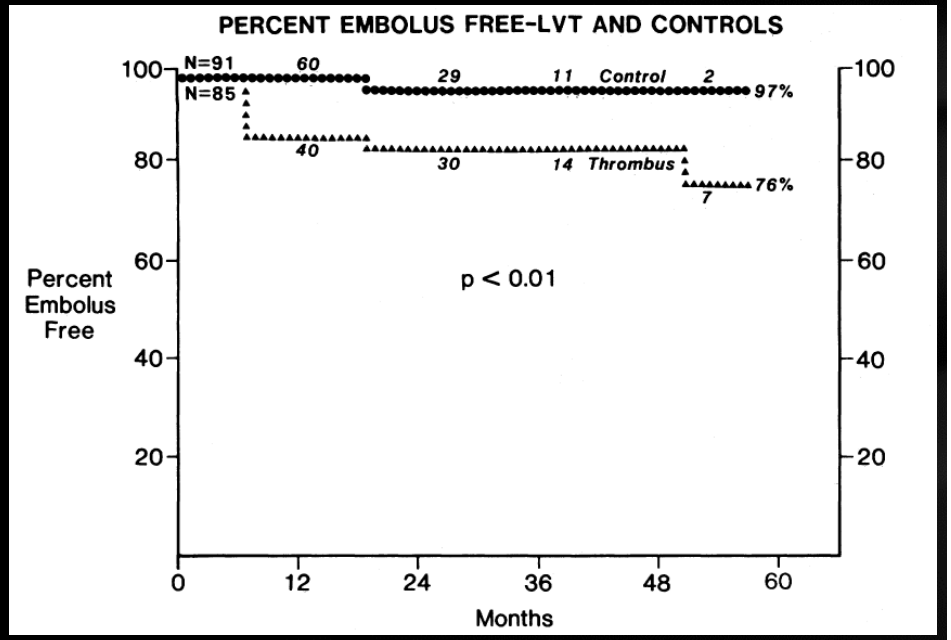
Cardiogenic Stroke: Causes

- Atrial fibrillation
- **Ischemic Heart Disease**
  - Recent Myocardial infarction
  - Ischemic cardiomyopathy/LV aneurysm
- Paradoxical Emboli
- Valvular Heart Disease
  - Mechanical prosthetic valve
  - Rheumatic mitral stenosis
  - Endocarditis
- Dilated cardiomyopathy
- Cardiac tumors

LV Thrombi and Embolic Risk

Increased embolic risk in patients with left ventricular thrombi

JOHN R. STRATTON, M.D., AND ARTHUR D. RESNICK, M.D.

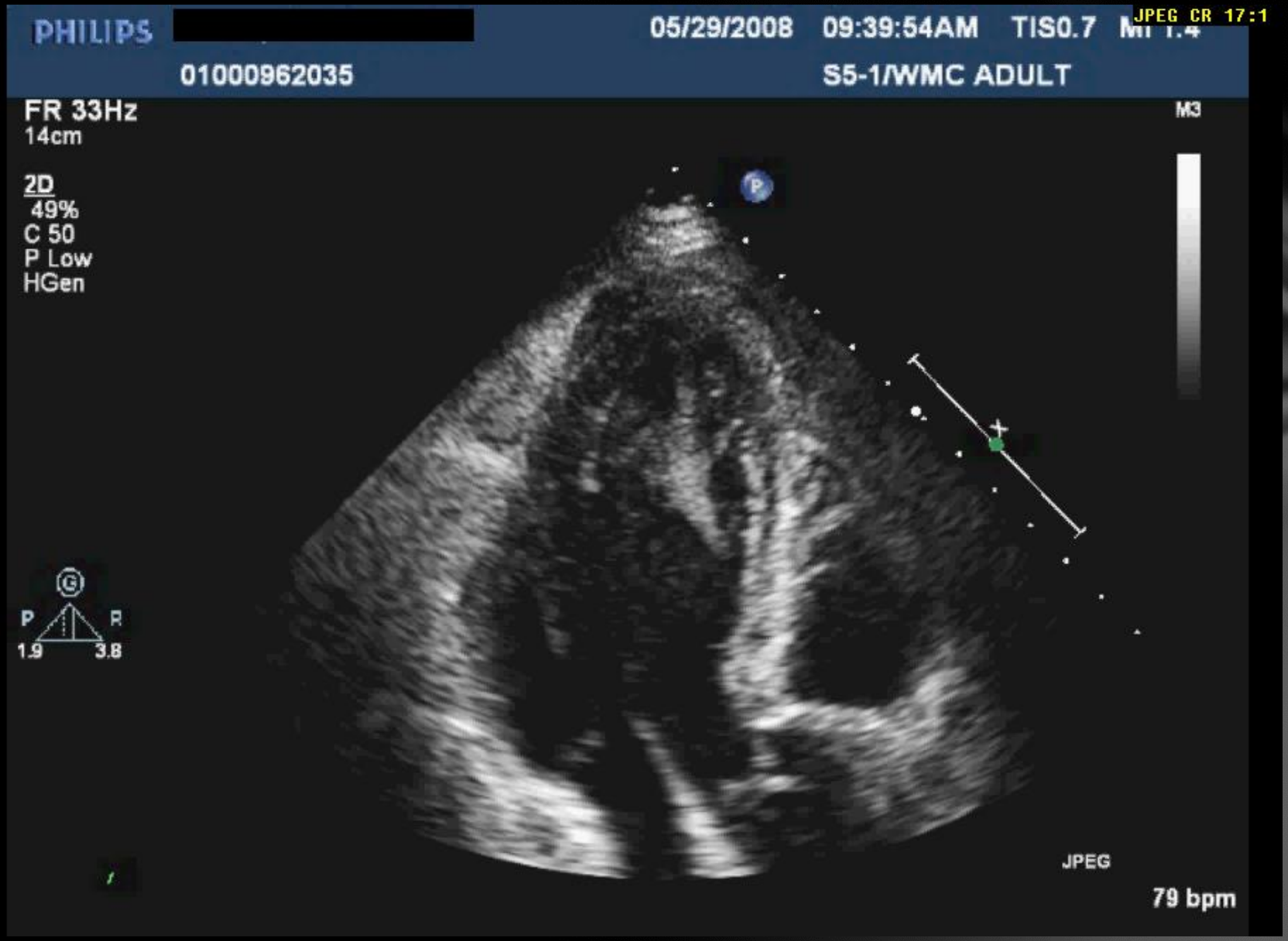


Circulation 75, No. 5, 1004-1011, 1987.

TABLE 5
Comparison of patients in the thrombus group with and without embolization during follow-up

	Patients with emboli (n = 11)	Patients without emboli (n = 74)	p value
Clinical features			
Age (years)	58 ± 7	61 ± 10	NS
Prior MI (%)	91	86	NS
Interval from MI to echo exam (months)	50 ± 76	29 ± 47	NS
Ejection fraction (n = 67)	0.34 ± 0.18	0.30 ± 0.14	NS
Chronic or paroxysmal atrial fibrillation (%)	18	13	NS
MI during follow-up (%)	18	8	NS
Echocardiographic features			
Left ventricular aneurysm (%)	73	75	NS
Thrombus thickness (cm)	2.8 ± 1.0	2.8 ± 1.2	NS
Thrombus protrusion (%)	90	49	<.02
Thrombus mobility (%)	70	20	<.01

MI = myocardial infarction; NS = not significant (p > .05).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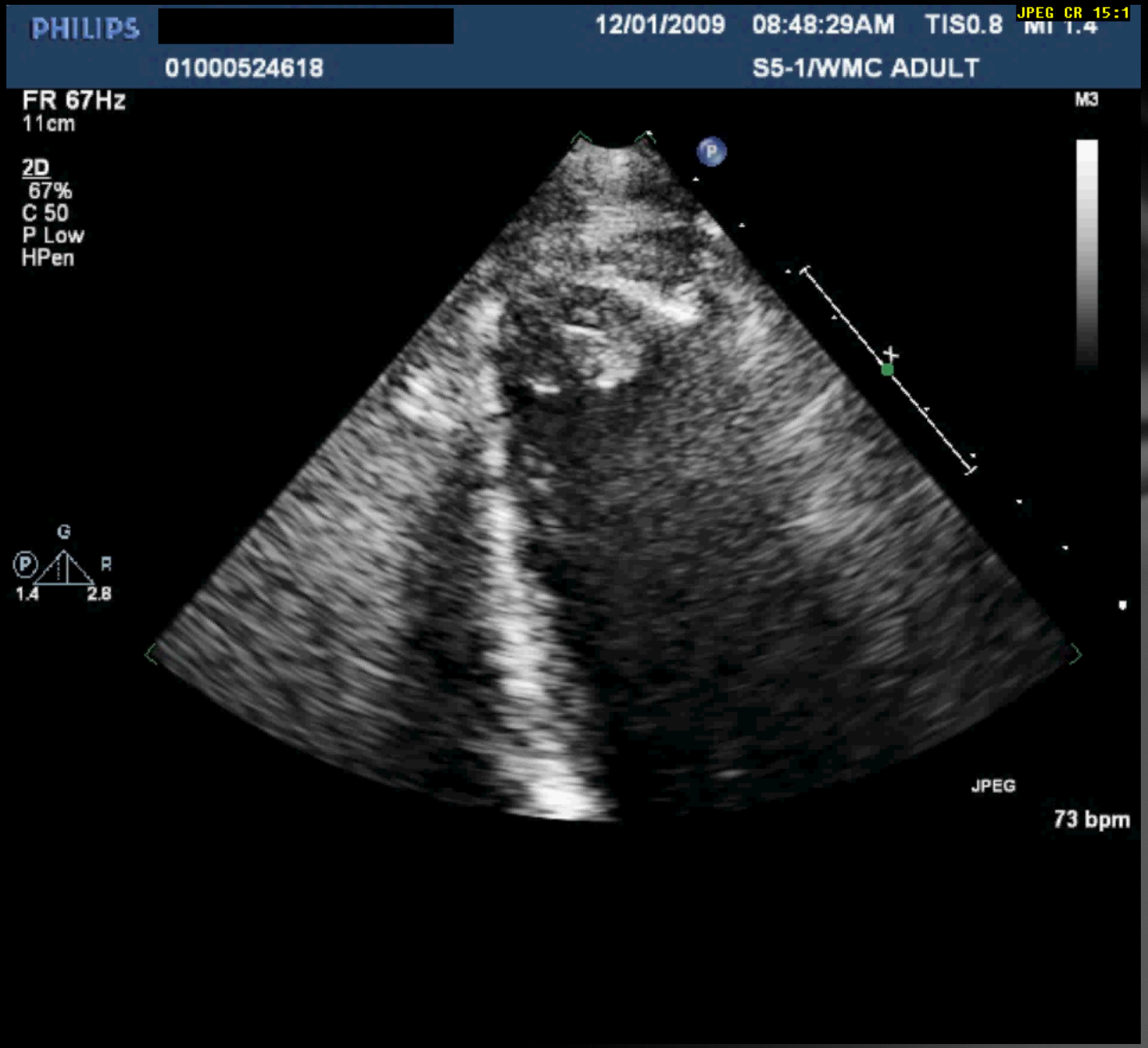
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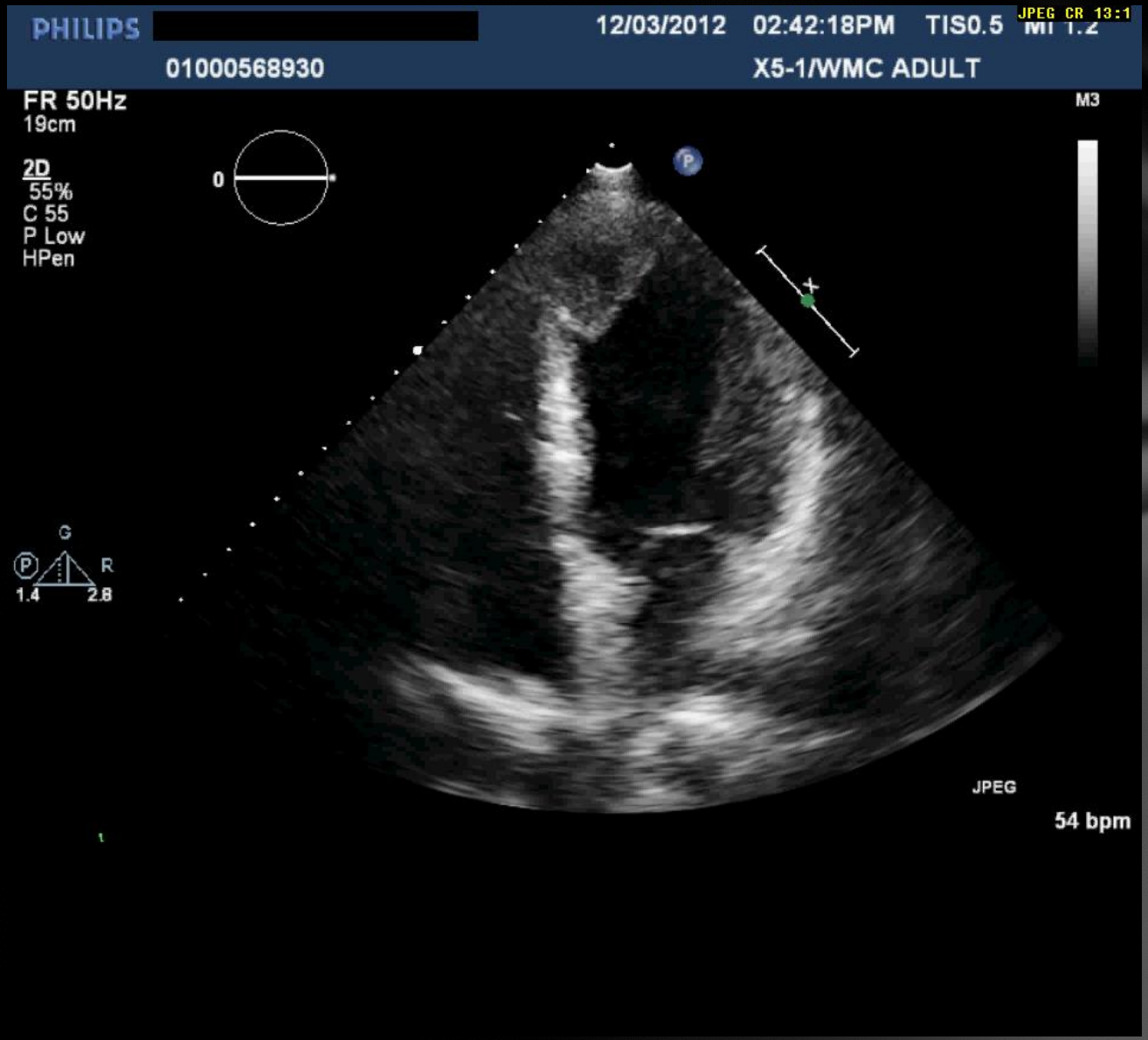
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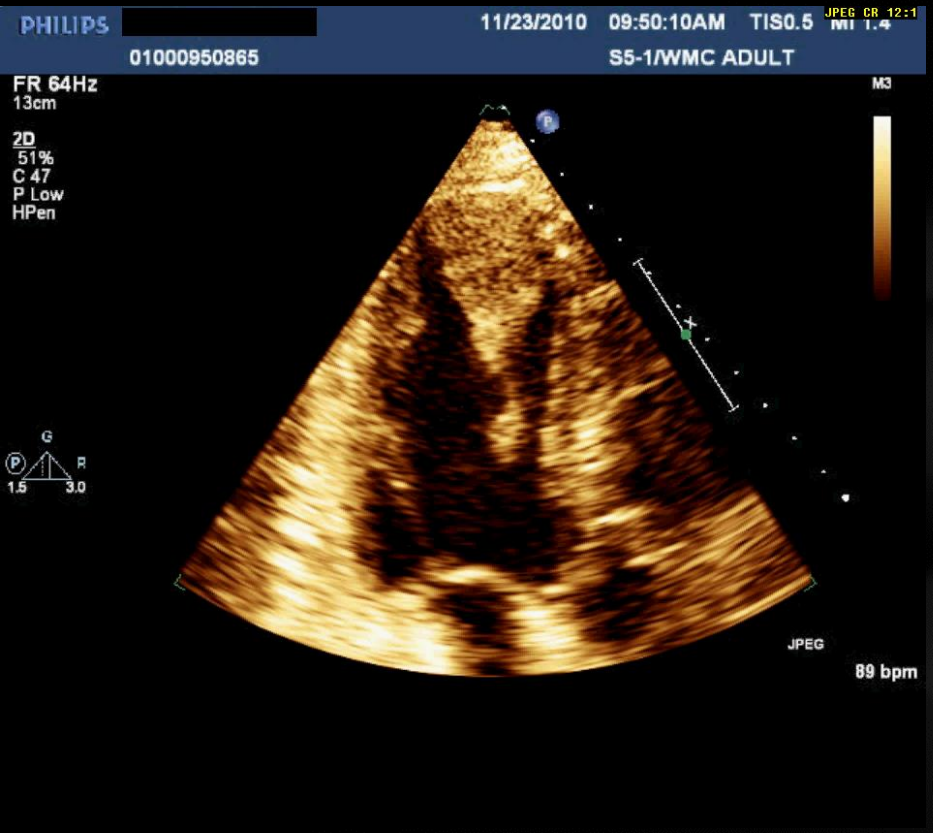
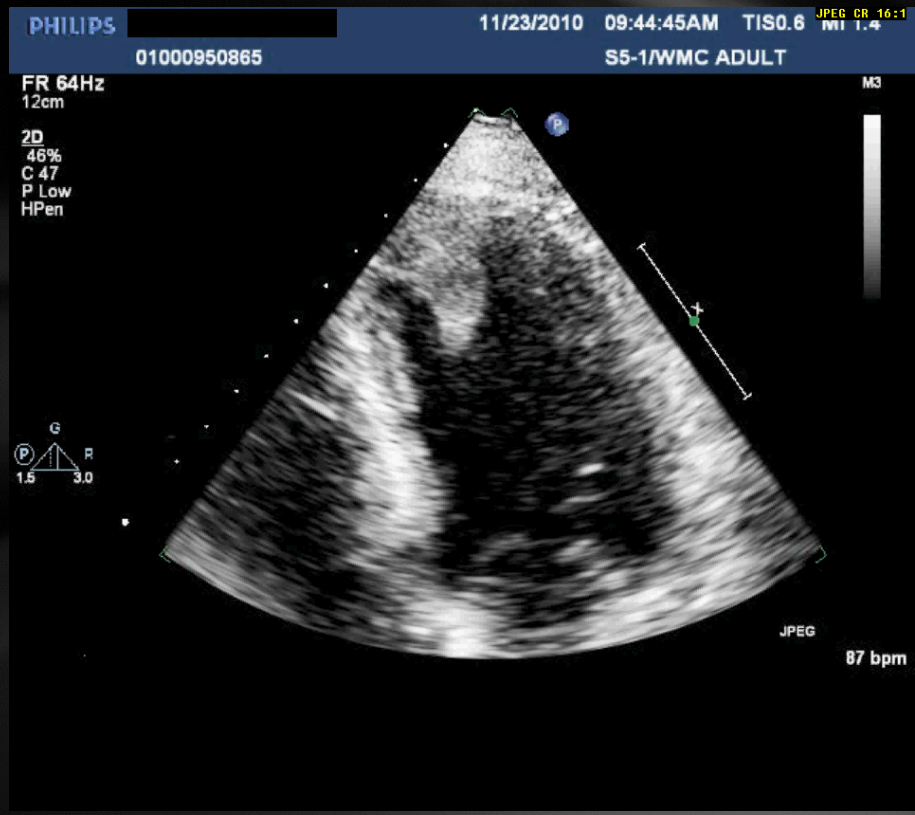
Anterior Apical MI





Cardiogenic Stroke: Causes

- Atrial fibrillation
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  - Recent Myocardial infarction
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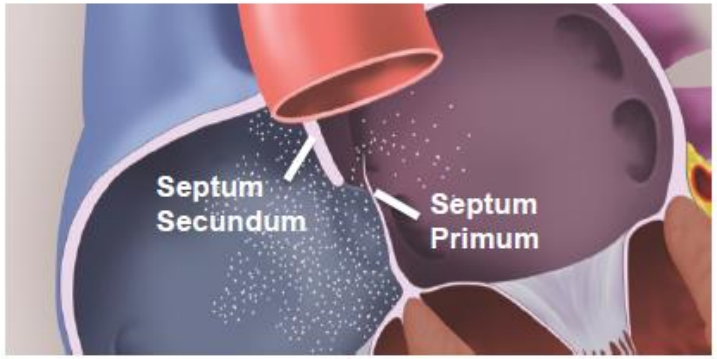
- **Paradoxical Emboli**
- Valvular Heart Disease
  - Mechanical prosthetic valve
  - Rheumatic mitral stenosis
  - Endocarditis
- Dilated cardiomyopathy
- Cardiac tumors

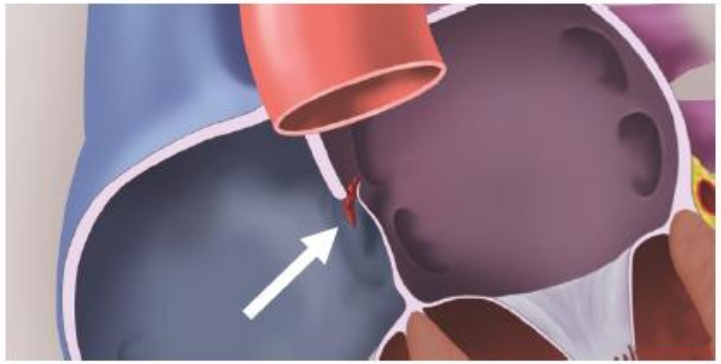
Patent Foramen Ovale

- Basic physiology:
  - In fetal life, blood is shunted from the right to left atrium through the foramen ovale.
  - After birth, the PFO closes in 75%
  - But may be patentin up to 75% of patients with unexplained stroke
- Strong association between PFO and stroke in patients under 55 years of age:
  - Stroke can occur due to
    - Paradoxical embolism
    - In-situ thrombosis?

Agitated saline study demonstrating right to left shunting through the PFO

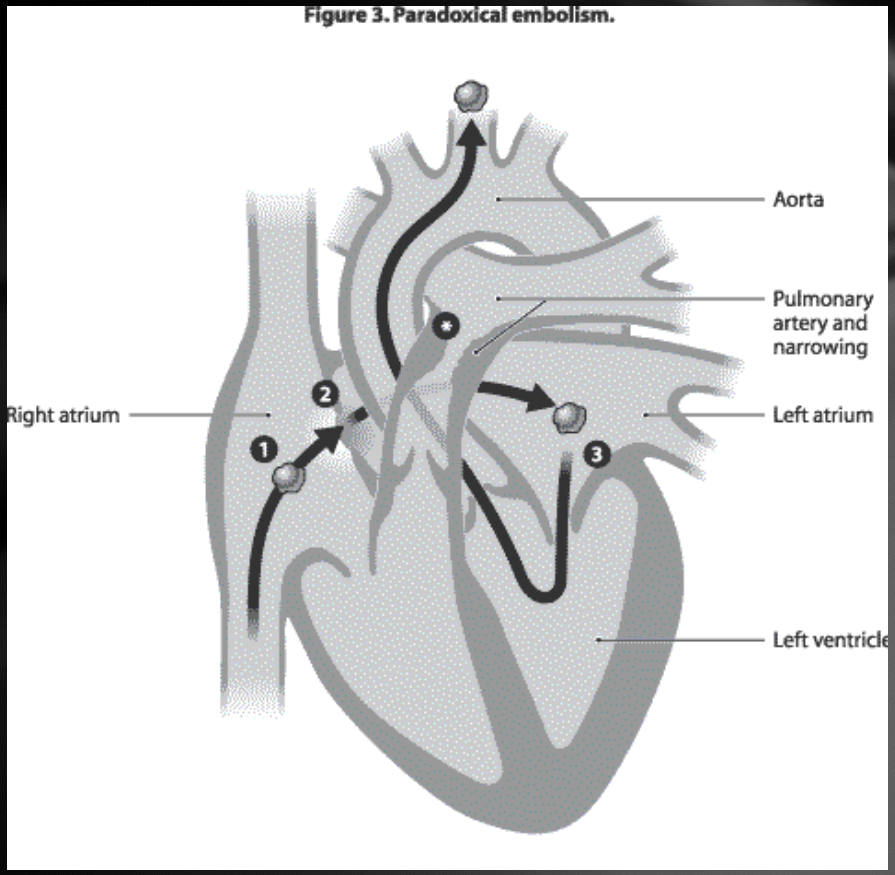


Blood clot passing through the PFO becoming a paradoxical embolism

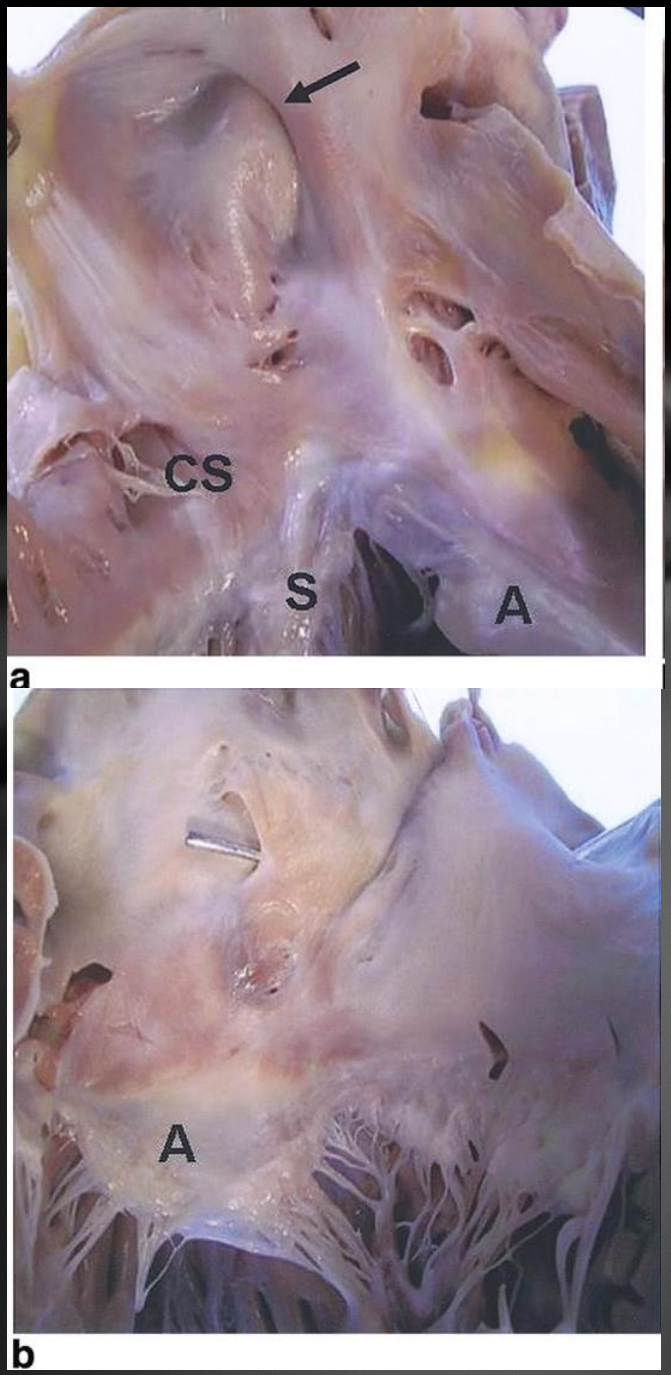


Paradoxical embolism

- **Definition:**
  - A systemic embolism (stroke or other) due migration of thrombus, air, or tumor particle from the venous to the arterial circulation, usually due to the presence of an intracardiac communication with right to left shunting.
- **Right to Left Shunts:**
  - Patent foramen ovale
  - ASD or VSD (rare)
  - Pulmonary AVM

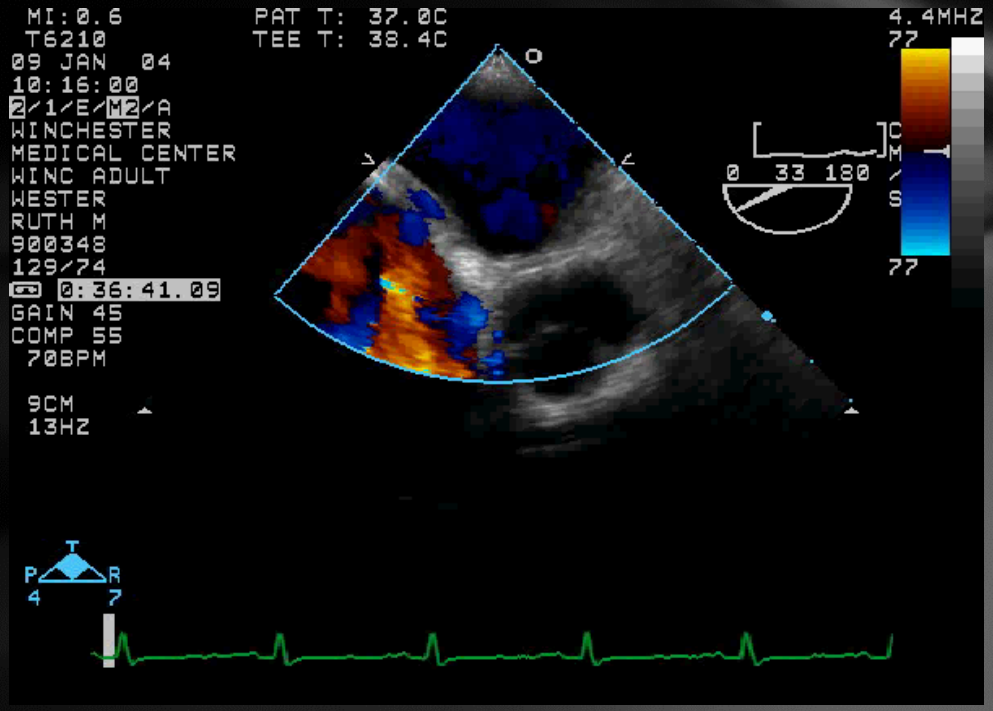


PFO: Gross Anatomy



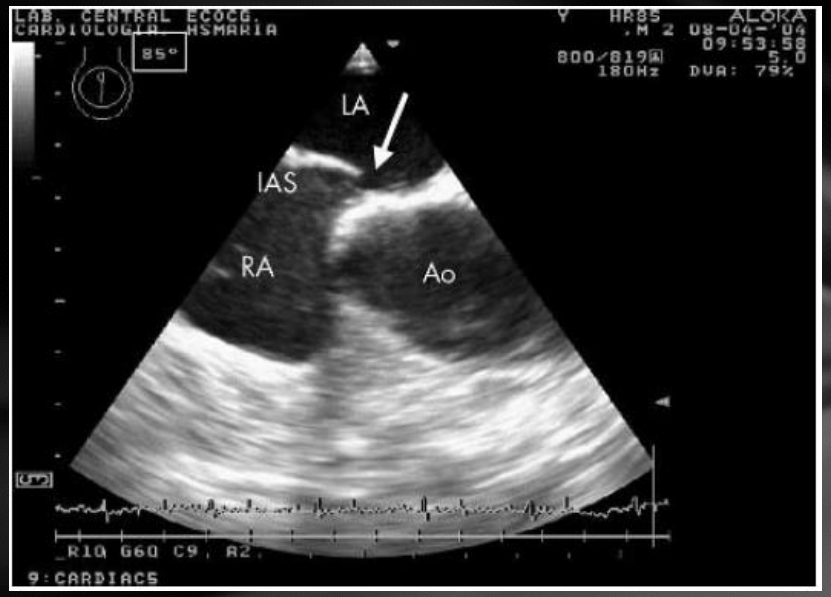
Patent Foramen Ovale

- Diagnosis by echo with agitated saline contrast:
  - PFO judged present if microbubbles seen within left sided chambers within 3 heartbeats from maximal right atrial opacification
  - TEE more sensitive than TTE
  - Lower extremity injections more likely to be positive
  - Doppler color flow less sensitive
  - Transcranial Doppler (not specific for PFO)



Agitated Saline Contrast:"Bubble Study"

- Bubbles in agitated saline **are 22-144** microns Vs. pulmonary capillaries **5.5** microns
- Magnitude of the observed contrast shunt influenced by
  - Position of patient
  - Choice of and route of administration of contrast agent
    - Blood from SVC → Tricuspid valve
    - Blood from IVC → Fossa ovalis
  - Provocative maneuvers
  - Patient compliance

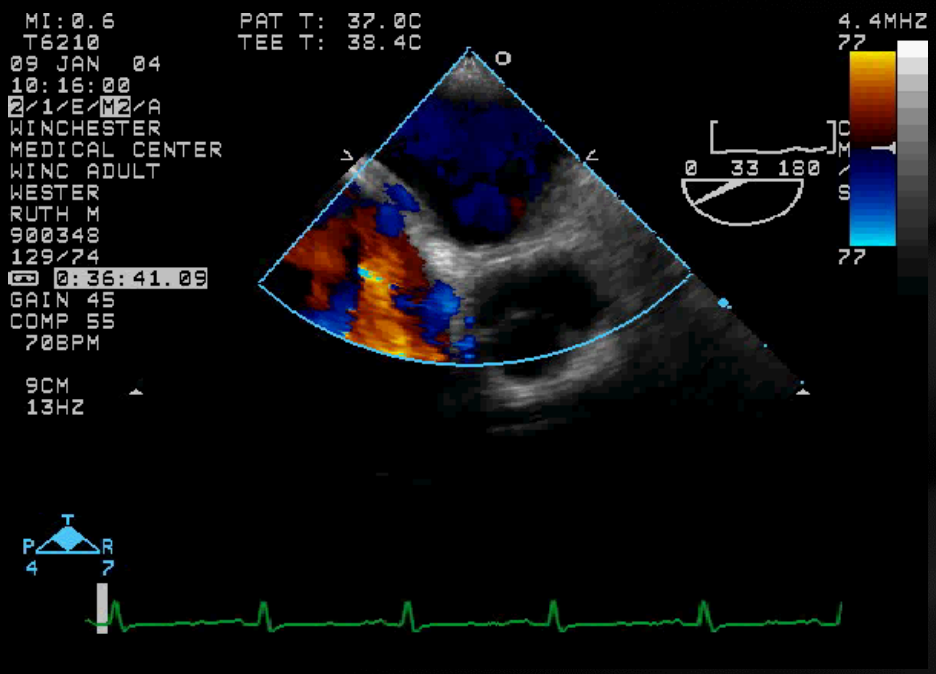


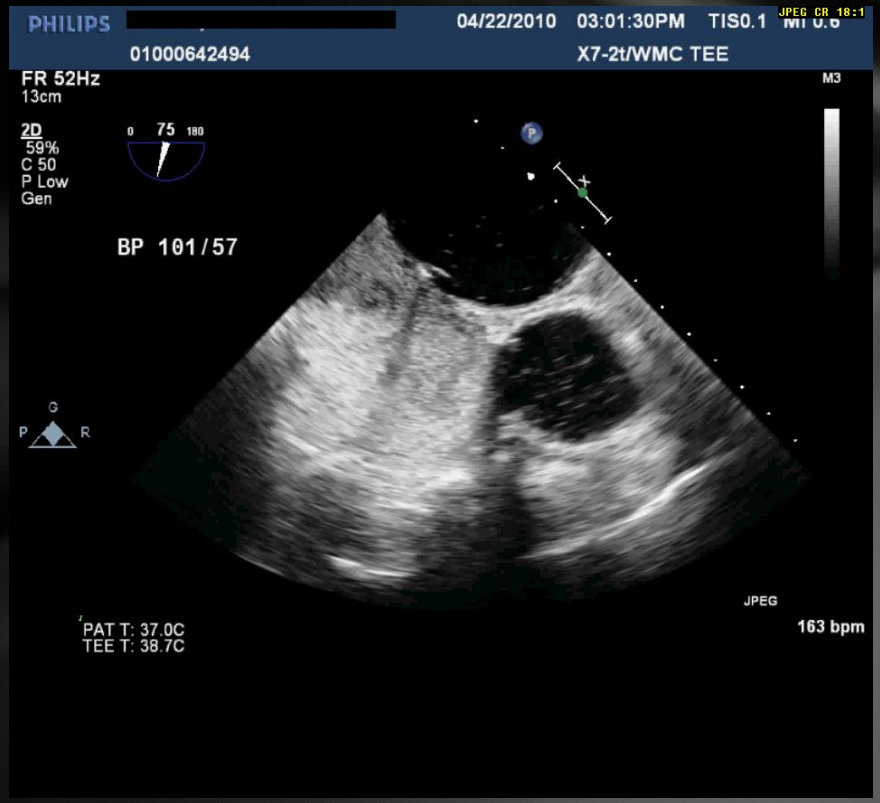
Heart 2005;**91**:438–440. doi: 10.1136/hrt.2004.052233

PFO: 3-D Transesophageal Echo

Patent foramen ovale -

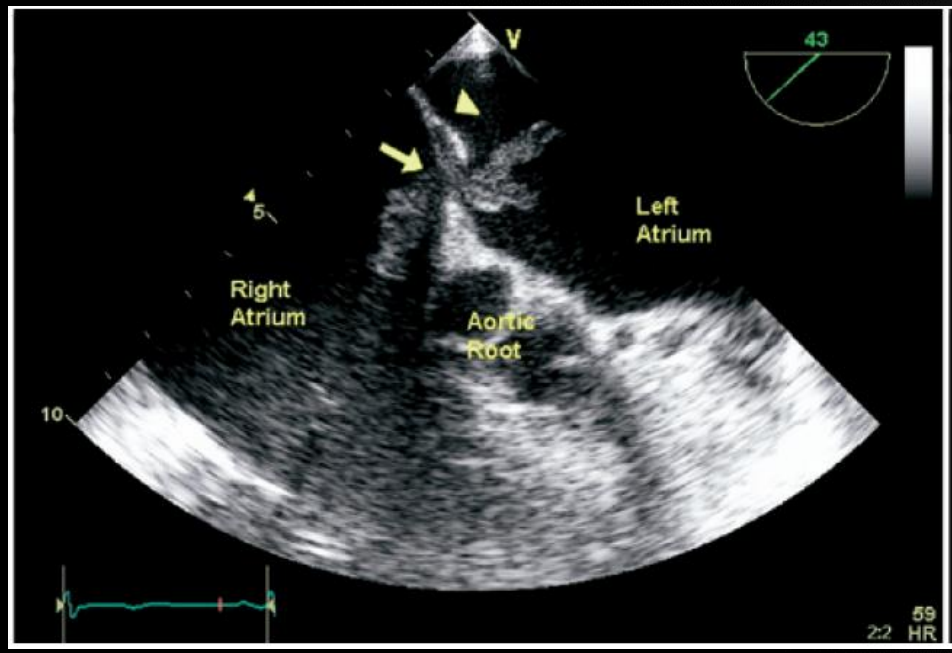
PFO: Transesophageal Echo

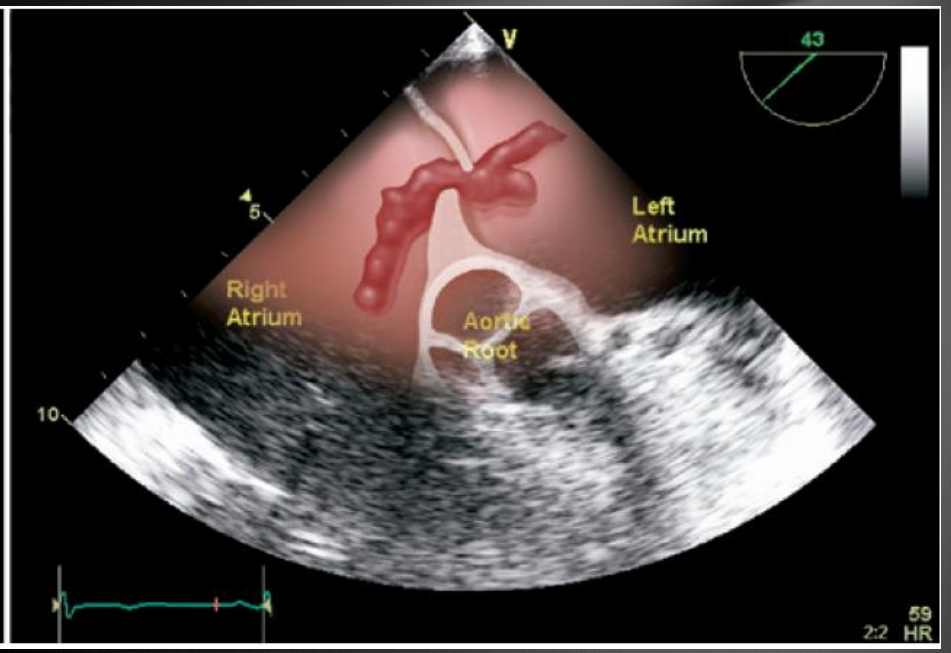




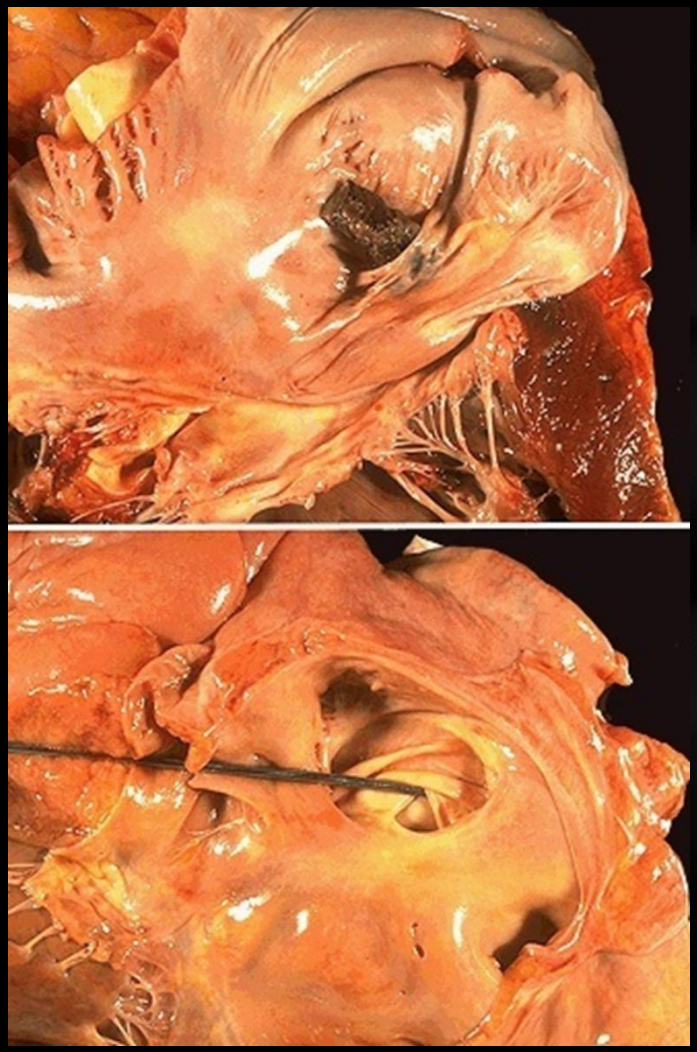
Paradoxical Embolism

- Venous source (usually thrombus) travels to the right heart chambers and ultimately finds its way to the arterial circulation,
- Not truly cardiogenic embolism since the heart is an innocent bystander which permits passage of embolic material.

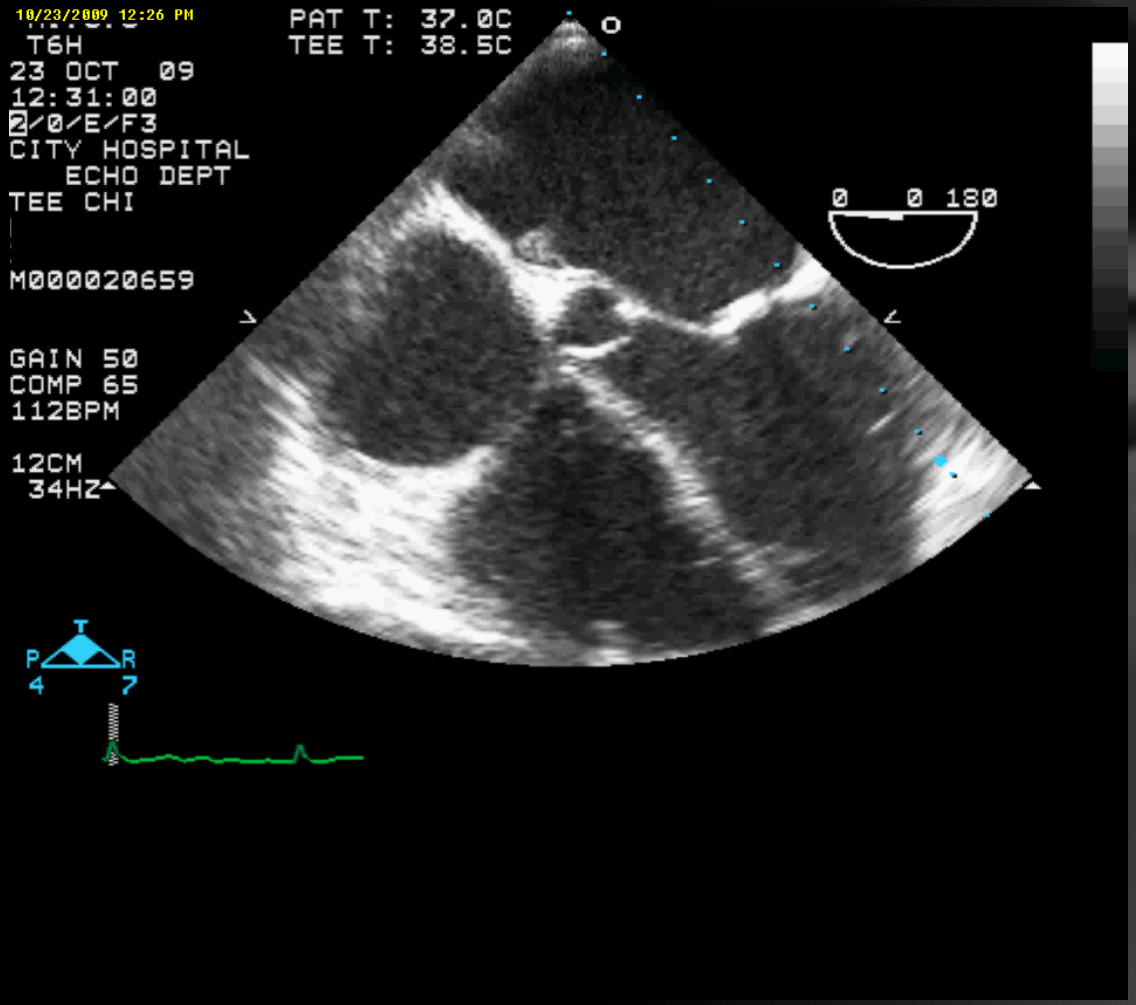




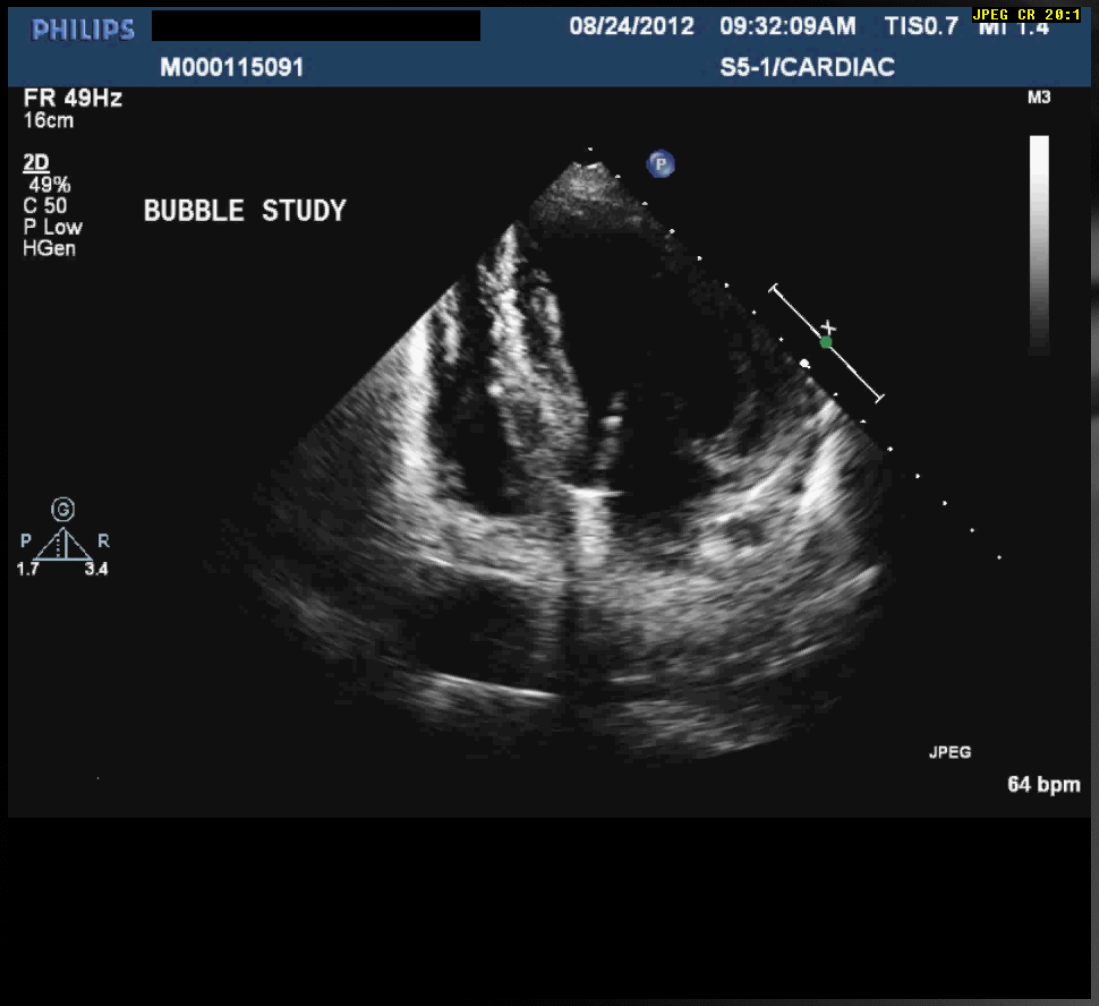
PFO: Paradoxical embolus in transit



Thrombus in PFO… in situ formation?



Positive "Bubble" Study: TTE



AMPLATZER PFO Occluder

RESPECT CLINICAL TRIAL

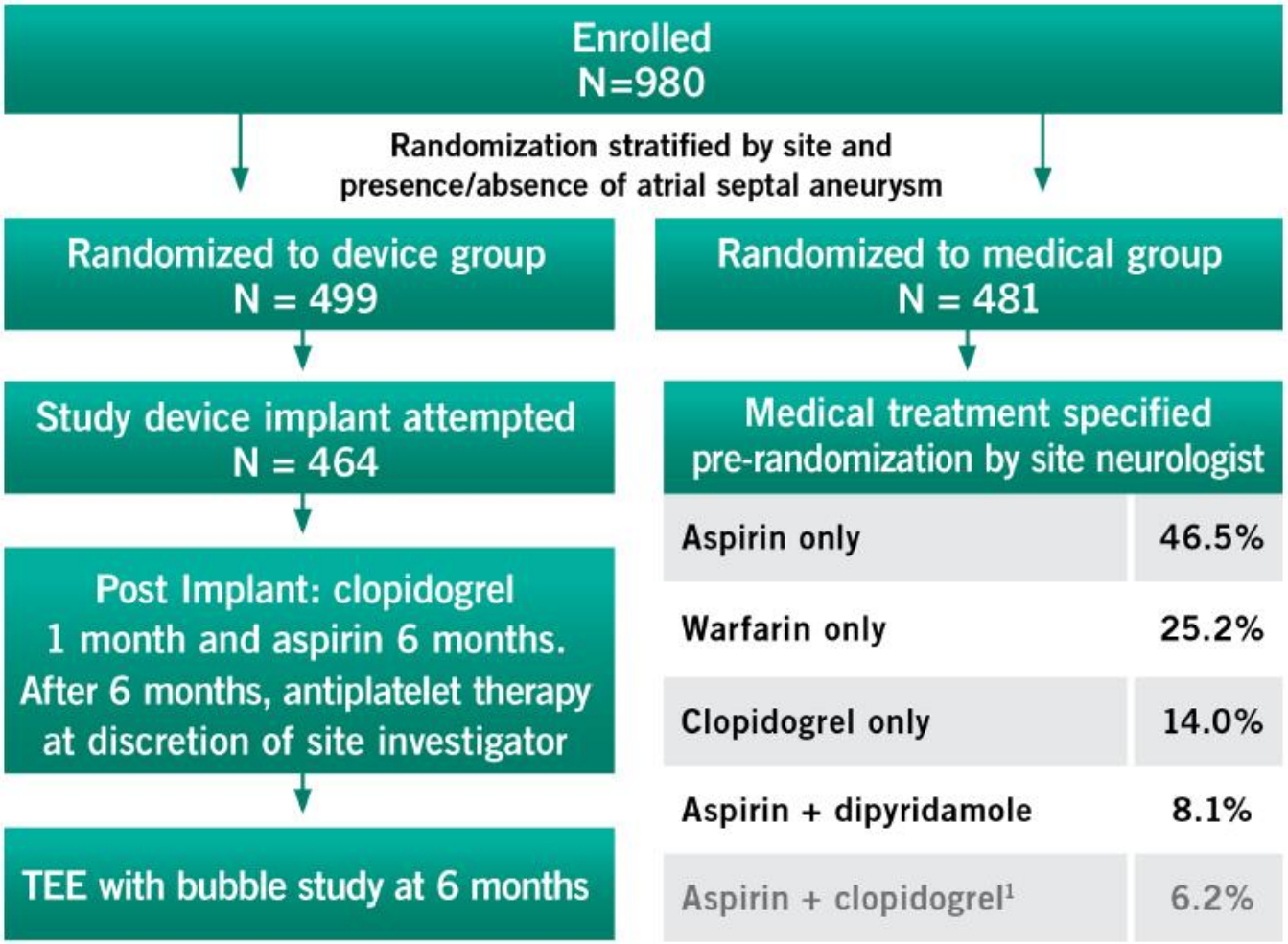
AMPLATZER PFO Occluder*

- Percutaneous, transcatheter device
- Self-expanding, double-disc design
- Nitinol wire mesh with polyester fabric/thread
- Radiopaque marker bands
- Sizes: 18, 25, 35 mm
- Recapturable and repositionable

*CAUTION: Investigational device in the United States. Limited by Federal (or U.S.) law to investigational use. Not available for sale in the U.S.

Subject Distribution

RESPECT
CLINICAL TRIAL



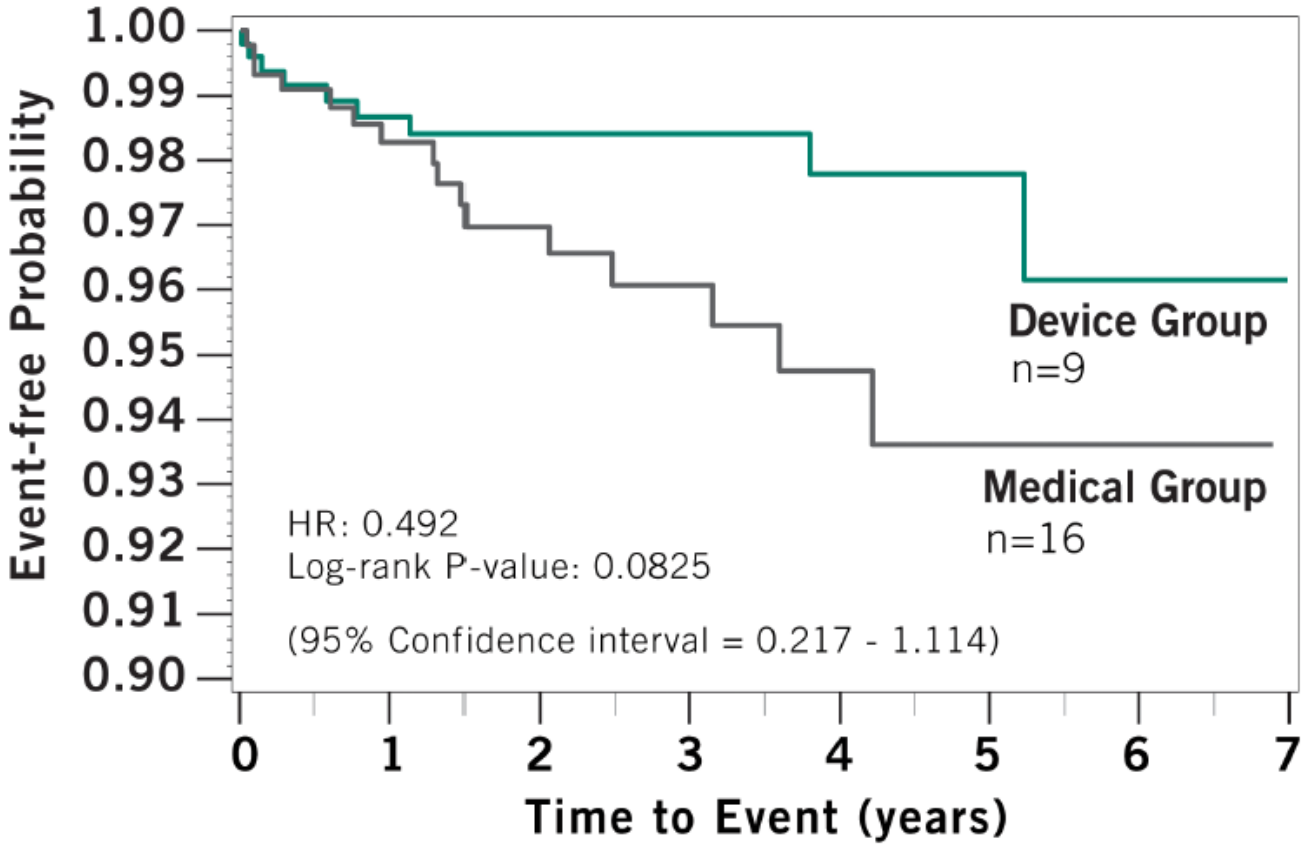
Medical treatment specified pre-randomization by site neurologist	
Aspirin only	46.5%
Warfarin only	25.2%
Clopidogrel only	14.0%
Aspirin + dipyridamole	8.1%
Aspirin + clopidogrel[1]	6.2%

1. Aspirin + clopidogrel was removed from the protocol in 2006 based on changes to the AHA/ASA treatment guidelines

Primary Endpoint Analysis – ITT Cohort

50.8% risk reduction of stroke in favor of device

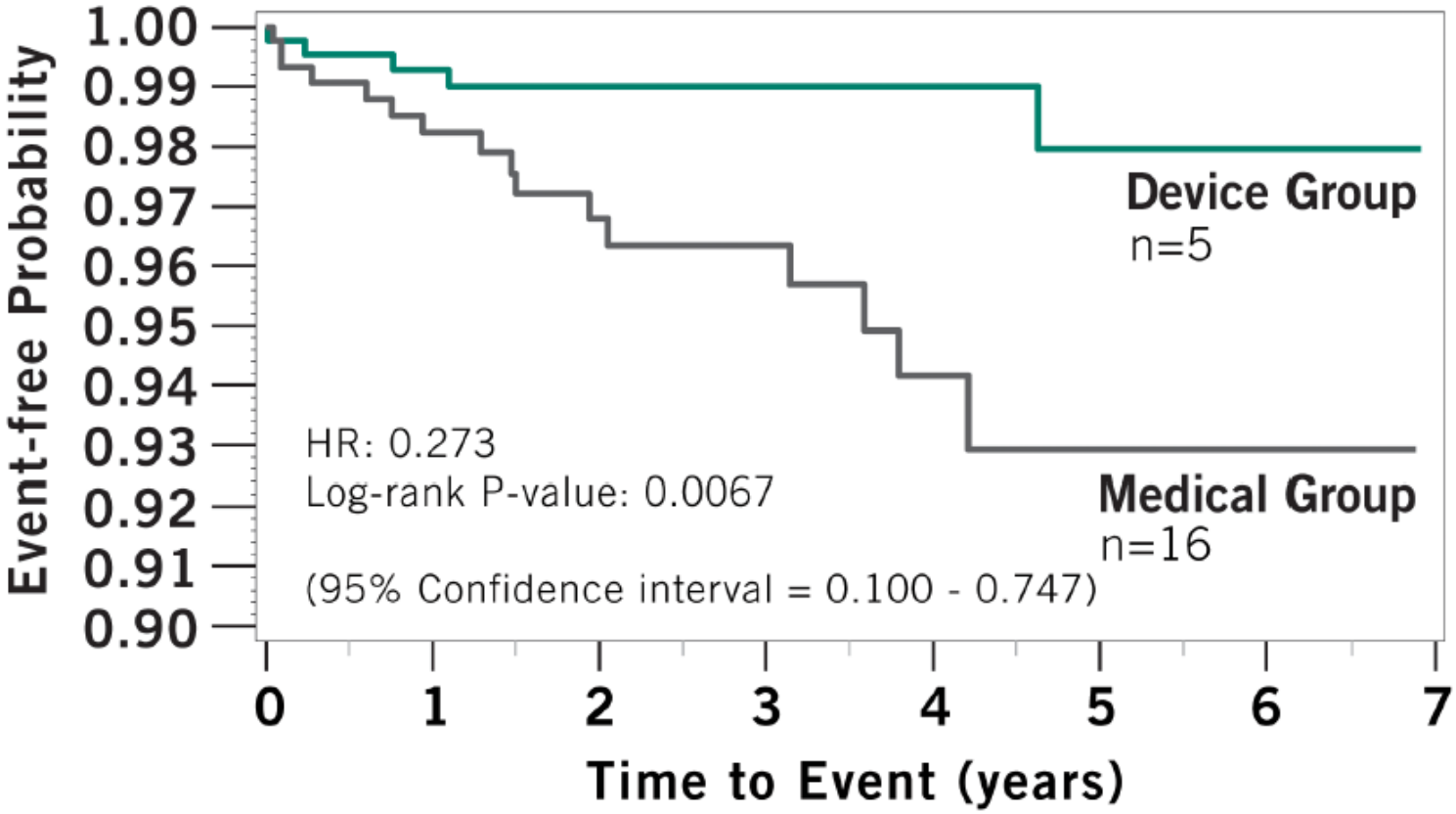
RESPECT CLINICAL TRIAL



- **3/9** device group patients did not have a device at time of endpoint stroke

1. Cox model used for analysis

Primary Endpoint Analysis – As Treated Cohort
72.7% risk reduction of stroke in favor of device



- The As Treated (AT) cohort demonstrates the treatment effect by classifying subjects into treatment groups according to the treatment actually received, regardless of the randomization assignment

1. Cox model used for analysis

Totality of Evidence and NNT

46.6%-72.7% risk reduction of stroke in favor of device

RESPECT CLINICAL TRIAL

Totality of Evidence

Analysis	Risk Reduction	P-Value[1]
Intent to Treat Raw Count	46.6%	0.157
Intent to Treat KM	50.8%	0.083
Per Protocol KM	63.4%	0.032
As Treated KM	72.7%	0.007

Number Needed to Treat (NNT)

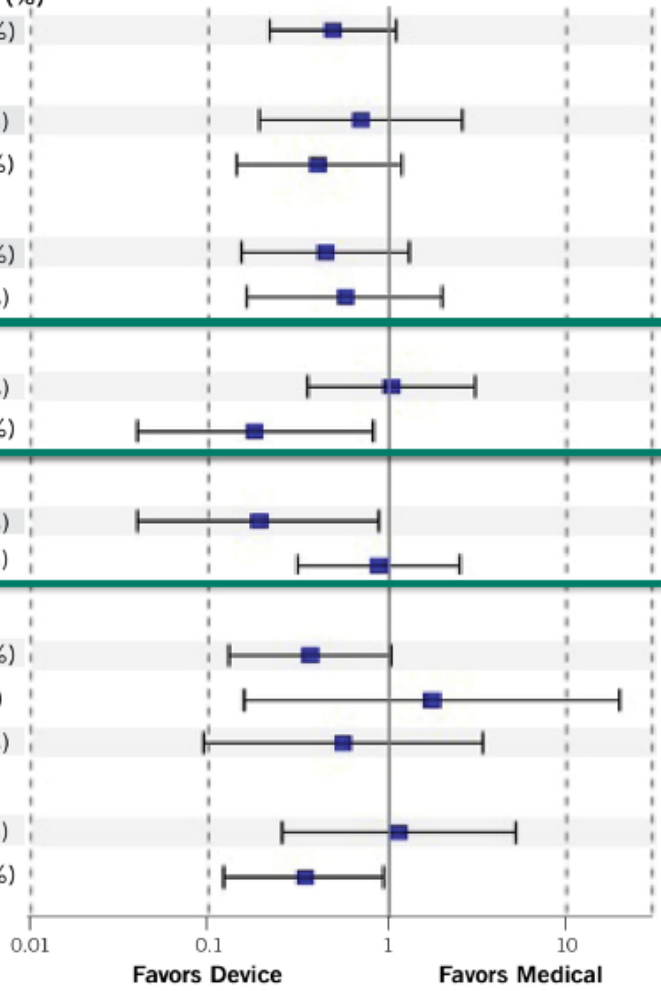
	NNT[2]	Device Group Event Rate[3]	Medical Group Event Rate[3]
1 Year	250	1.33%	1.73%
2 Year	70.4	1.60%	3.02%
5 Year	23.9	2.21%	6.40%

1. P-values: ITT Raw Count is calculated using Fisher's Exact test; all other P-values are calculated using log-rank test
2. The NNT is the average number of subjects that need to be treated with the AMPLATZER™ PFO Occluder in order to prevent one stroke in the respective time intervals. The NNT is calculated as the reciprocal of the difference between the control arm and device arm event rates
3. Calculated using the Kaplan-Meier estimated event rates for each treatment group

Subpopulation Differential Treatment Effect

RESPECT CLINICAL TRIAL

Subgroup	Device Group	Medical Group	Hazard Ratio and 95% CI		Pvalue (Log Rank)	Interaction Pvalue
	no. of patients/total number (%)					
Overall	9/499 (1.8%)	16/481 (3.3%)		0.492 (0.217, 1.114)	0.0825	
Age						0.5156
- 18-45	4/230 (1.7%)	5/210 (2.4%)		0.698 (0.187, 2.601)	0.5901	
- 46-60	5/262 (1.9%)	11/266 (4.1%)		0.405 (0.140, 1.165)	0.0828	
Sex						0.7312
- Male	5/268 (1.9%)	10/268 (3.7%)		0.448 (0.153, 1.311)	0.1321	
- Female	4/231 (1.7%)	6/213 (2.8%)		0.571 (0.161, 2.024)	0.3789	
Shunt Size						0.0667
- None, trace or moderate	7/247 (2.8%)	6/244 (2.5%)		1.034 (0.347, 3.081)	0.9527	
- Substantial	2/247 (0.8%)	10/231 (4.3%)		0.178 (0.039, 0.813)	0.0119	
Atrial septal aneurysm						0.1016
- Present	2/180 (1.1%)	9/169 (5.3%)		0.187 (0.040, 0.867)	0.0163	
- Absent	7/319 (2.2%)	7/312 (2.2%)		0.889 (0.312, 2.535)	0.8259	
Index infarct topography						0.3916
- Superficial	5/280 (1.8%)	12/269 (4.5%)		0.366 (0.129, 1.038)	0.0487	
- Small Deep	2/57 (3.5%)	1/70 (1.4%)		1.762 (0.156, 19.93)	0.6429	
- Other	2/157 (1.3%)	3/139 (2.2%)		0.558 (0.093, 3.340)	0.5167	
Planned medical regimen						0.1966
- Anticoagulant	4/132 (3.0%)	3/121 (2.5%)		1.141 (0.255, 5.098)	0.8628	
- Antiplatelet	5/367 (1.4%)	13/359 (3.6%)		0.336 (0.120, 0.944)	0.0299	

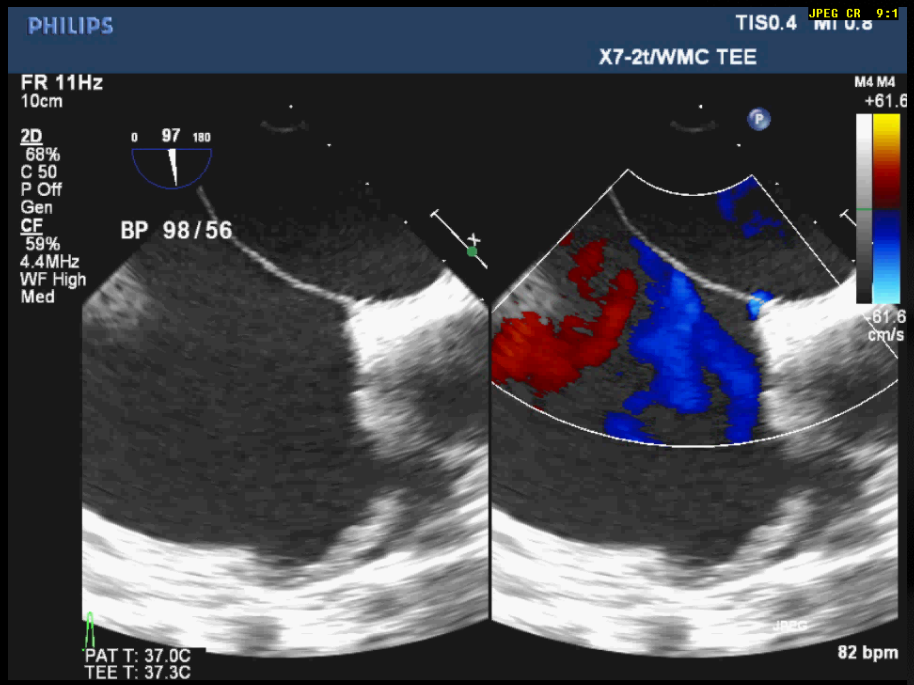


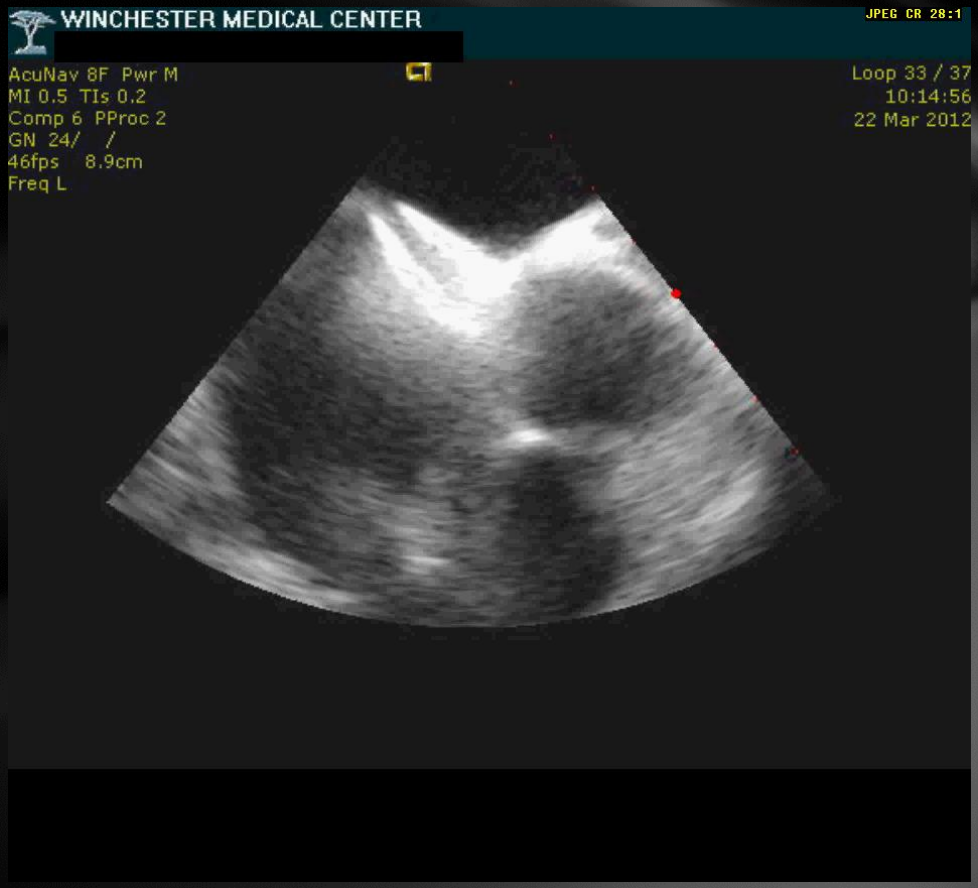
Conclusion

RESPECT CLINICAL TRIAL

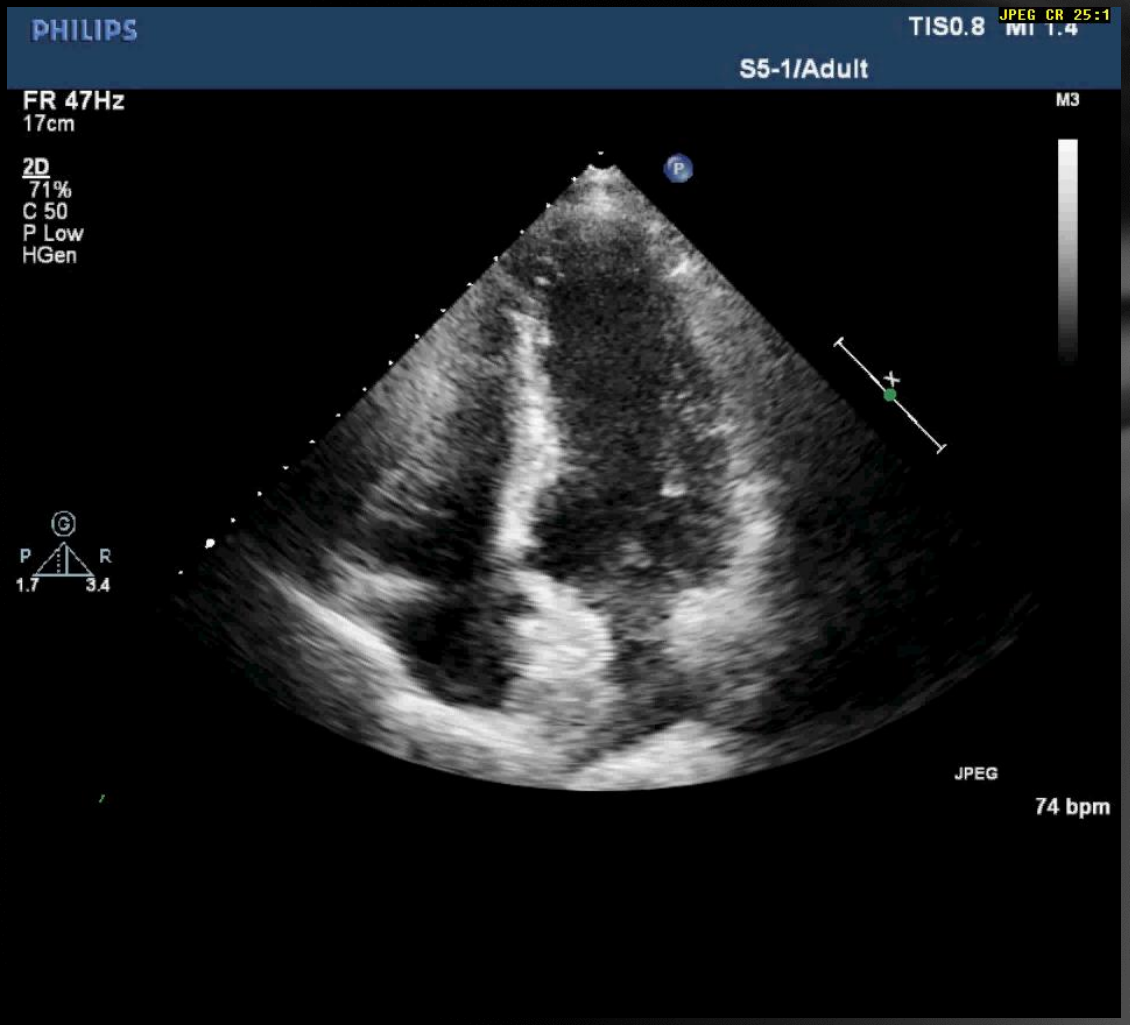
- For carefully selected patients with history of cryptogenic stroke and PFO, the RESPECT Trial provides evidence of benefit in stroke risk reduction from closure with the AMPLATZER PFO Occluder over medical management alone
  - Primary analysis of ITT cohort was not statistically significant but trended towards superiority while secondary analyses suggested superiority
  - Stroke risk reduction was observed across the totality of analyses with rates ranging from 46.6% - 72.7%
- PFO closure with the AMPLATZER PFO Occluder exposes patients to a very low risk of device- or procedure-related complications
- Results of the RESPECT Trial have substantial import for the treatment of patients with a history of cryptogenic stroke and PFO
- Follow-up of patients is on-going and will continue to provide additional longer term information regarding benefits, risks, and differential treatment effects in sub-populations

ASD Closure – Amplatzer Device

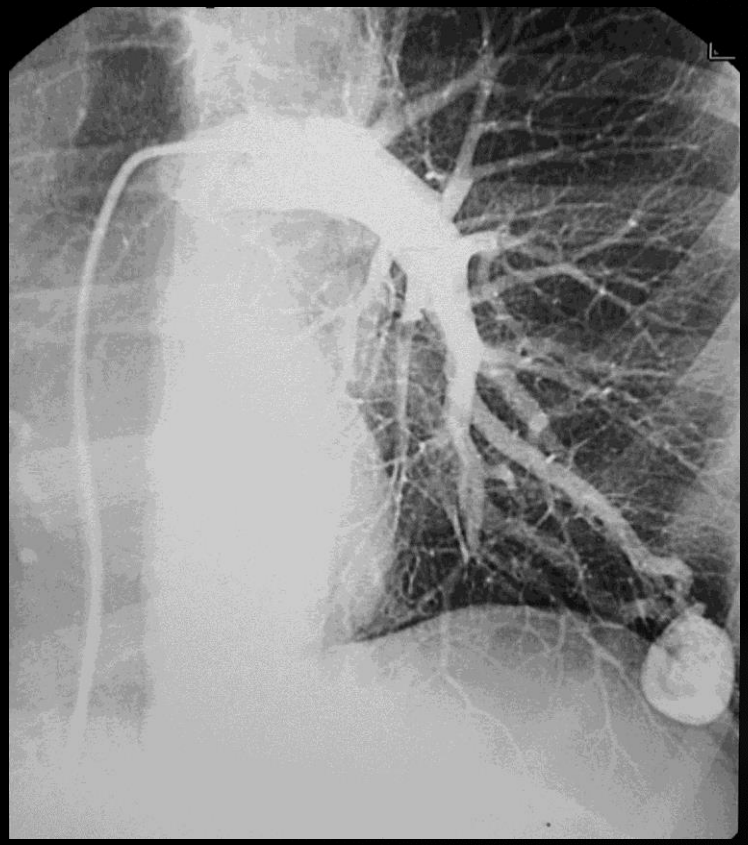


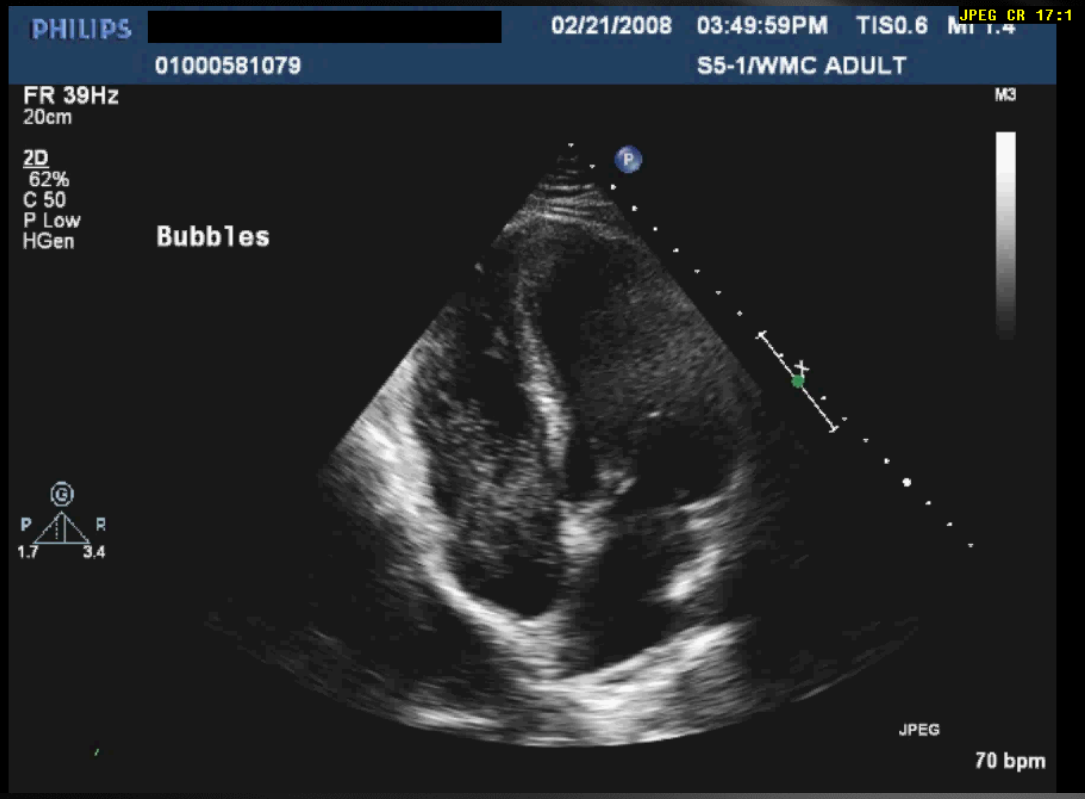


Apical 4-Chamber - Amplatzer



Alternate Pathway for Paradoxical Embolism



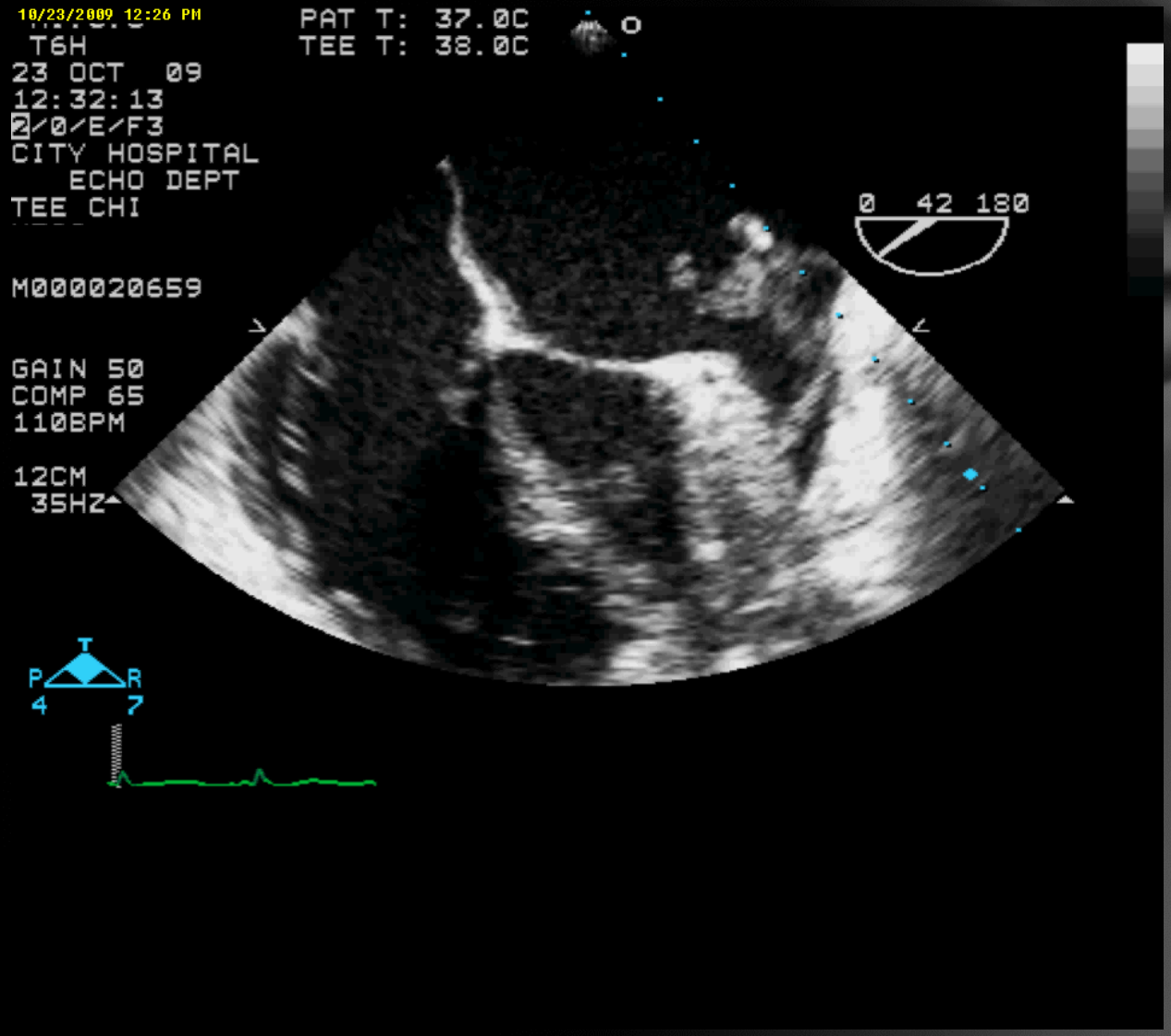


Pulmonary AVM – the lungs ordinarily act as a filter to trap particulates from the venous circulation and prevent arterial embolization

Cardiogenic Stroke: Causes

- Atrial fibrillation
- Ischemic Heart Disease
  - Recent Myocardial infarction
  - Ischemic cardiomyopathy/LV aneurysm
- Paradoxical Emboli
- **Valvular Heart Disease**
  - Mechanical prosthetic valve
  - Rheumatic mitral stenosis
  - Endocarditis
- Dilated cardiomyopathy
- Cardiac tumors

Rheumatic Mitral Stenosis



Case Presentation: 56 year old man

Acute right-sided weakness, impaired speech, reduced level of consciousness, possible seizure

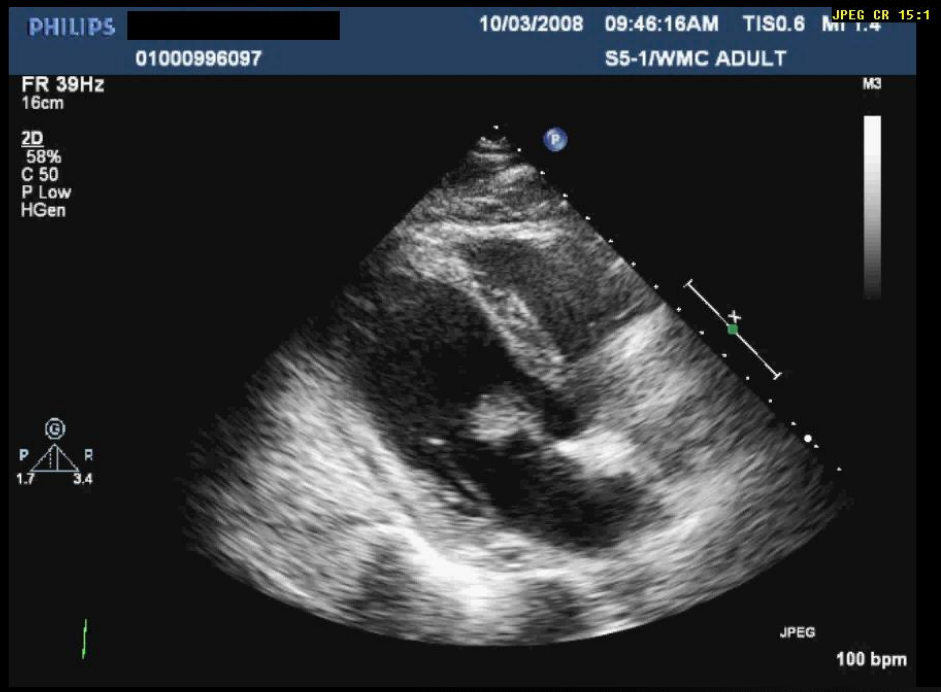
Reduced left brachial and radial pulses

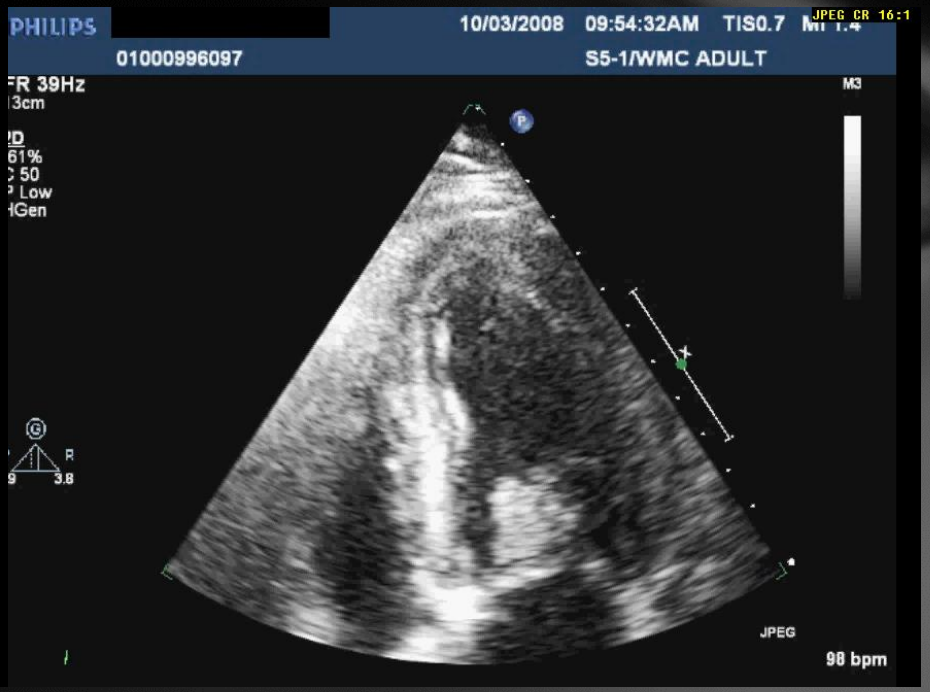
Head CT: large left parietal, bilateral posterior frontal intraparenchymal hemorrhages

Arterial Duplex Left Upper extremity: occluded left axillary artery

Echocardiogram

2D Echocardiogram

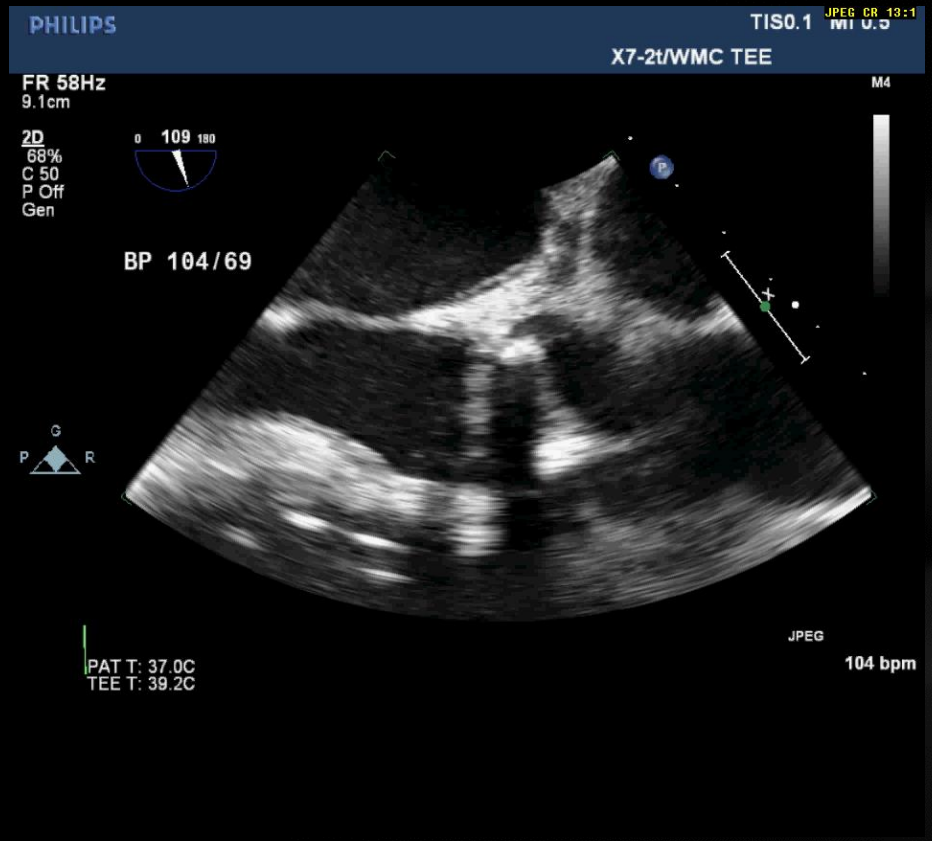


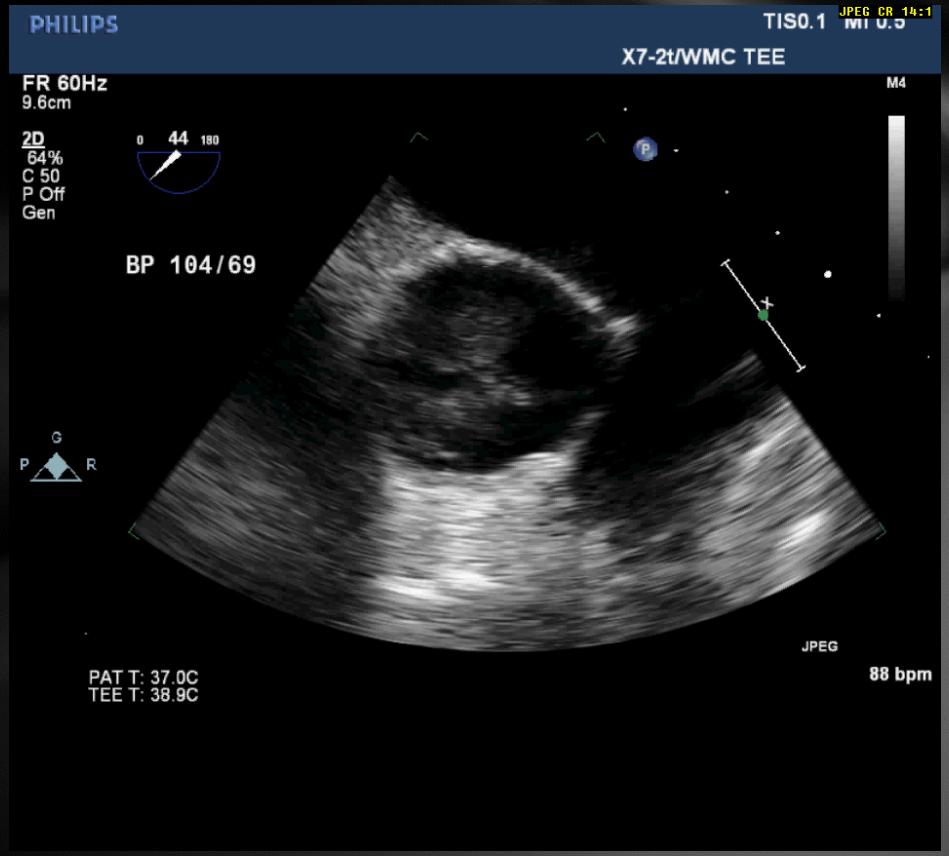


Differential Diagnosis:

- Primary cardiac tumor (Myxoma, Fibroelastoma)
- Endocarditis (esp. fugal)

Subacute Bacterial Endocarditis





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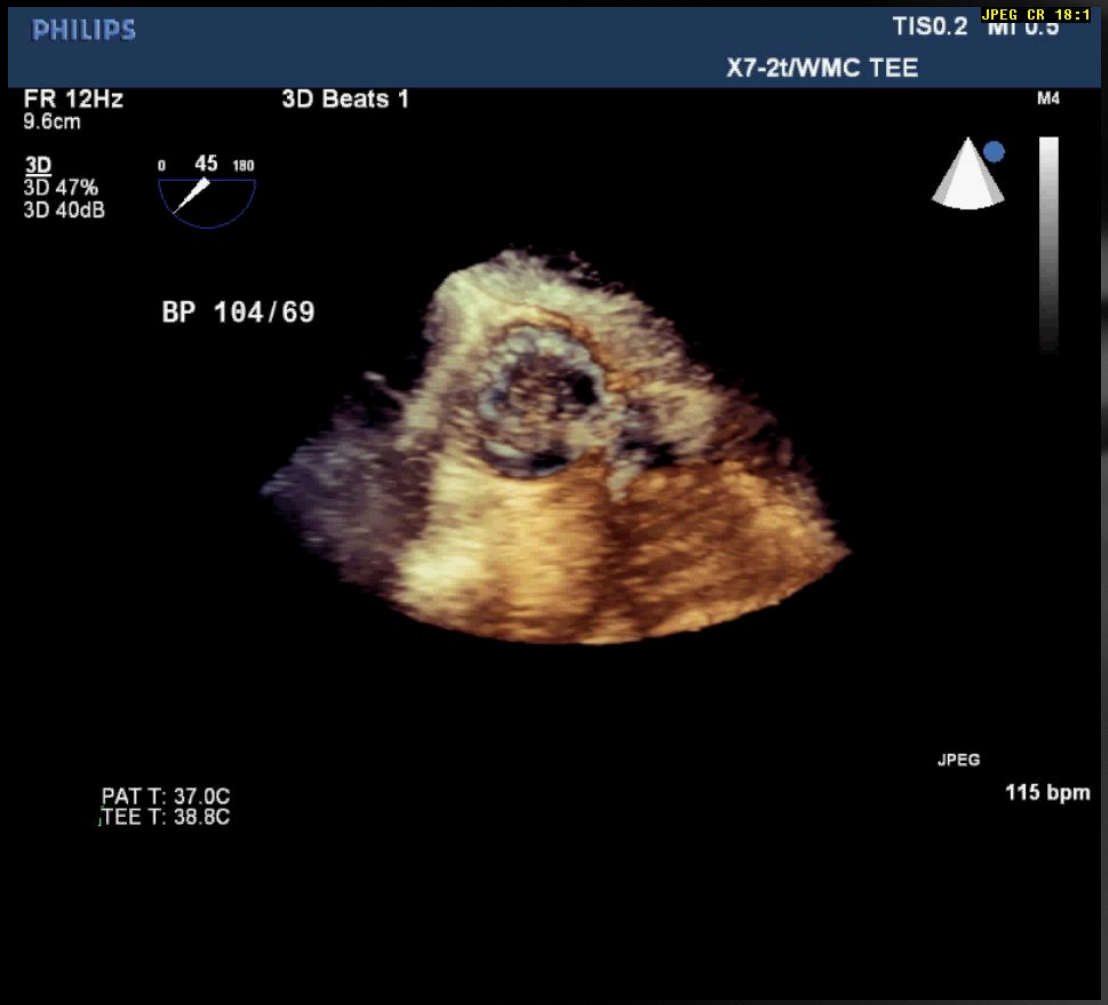
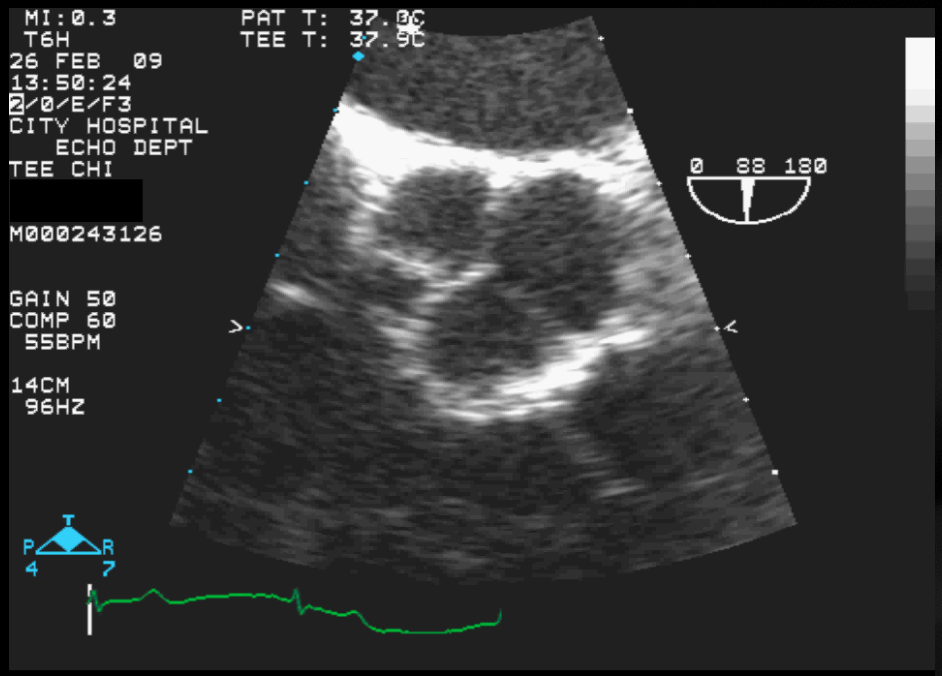
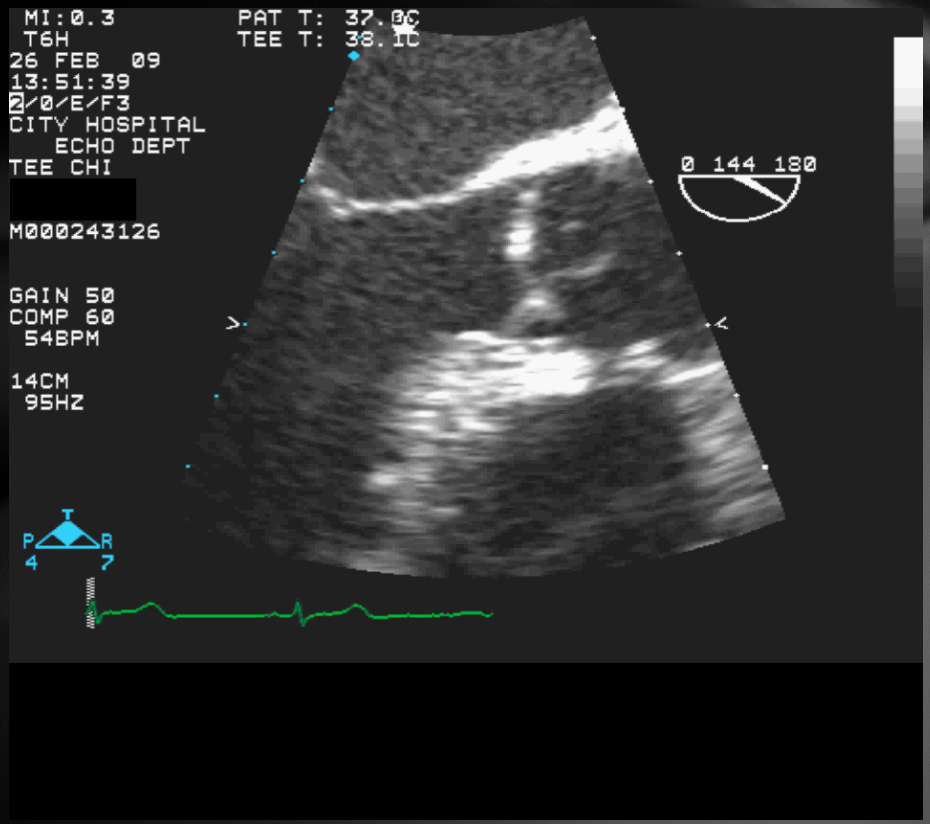
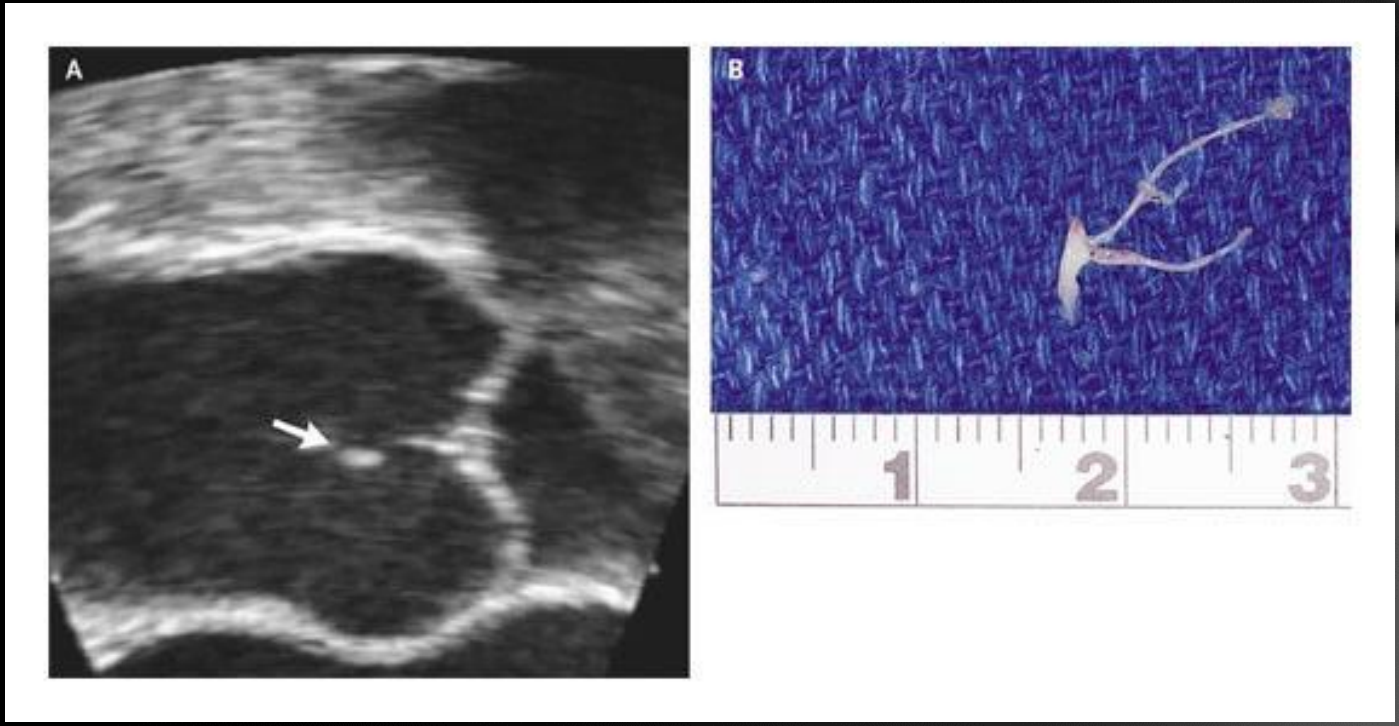


56 Year-old Woman with Stroke



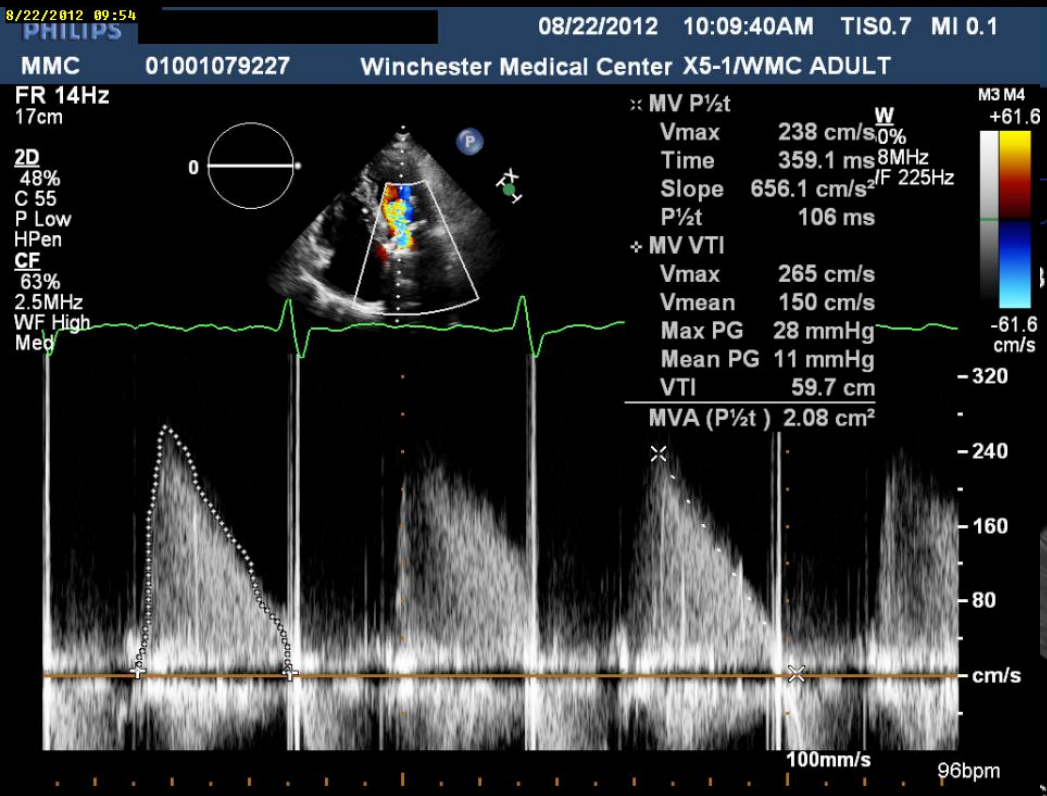


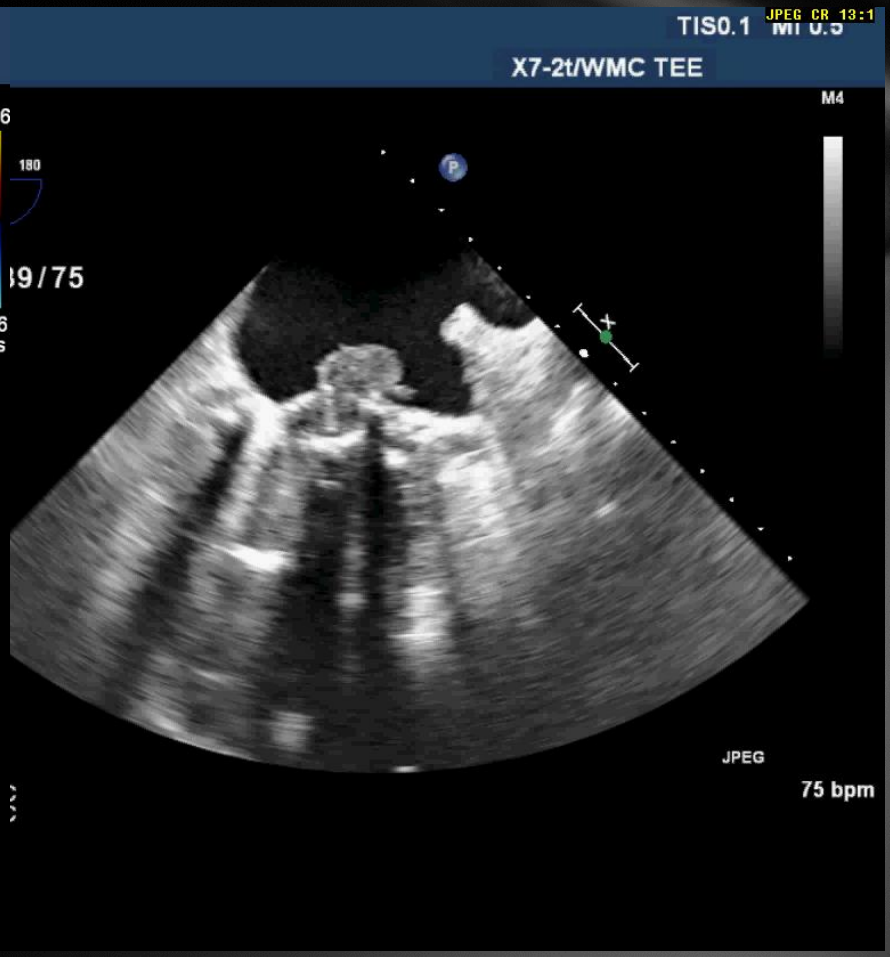
A 66-year-old, previously healthy woman presented with an acute onset of weakness on the left side of the body



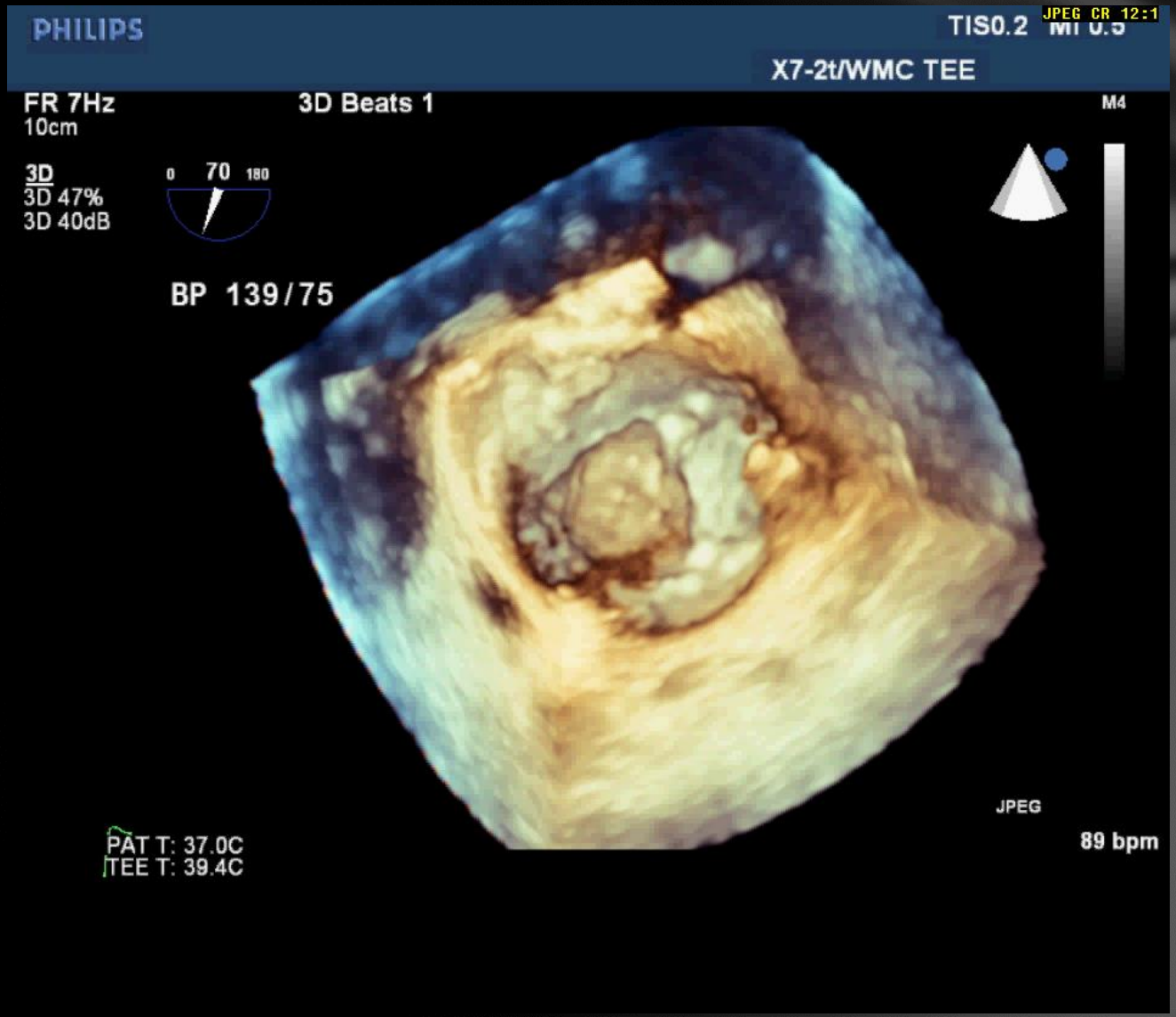
Aggarwal A and Leavitt B. N Engl J Med 2003;349:e24

Mechanical MV Thrombosis

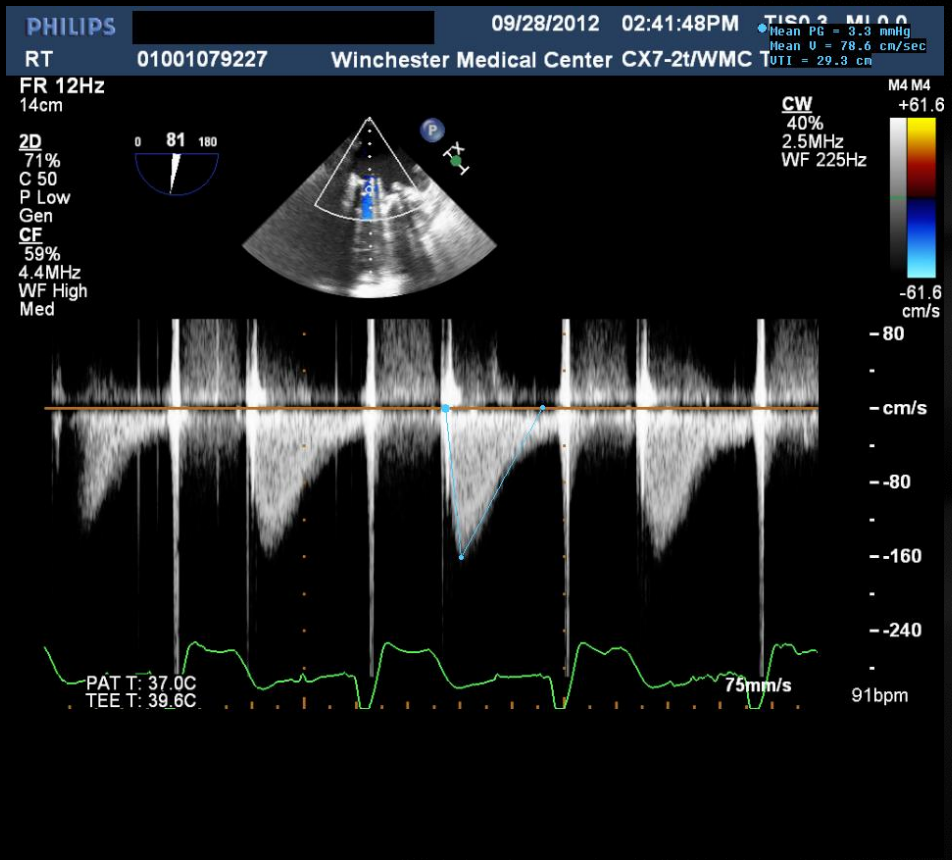


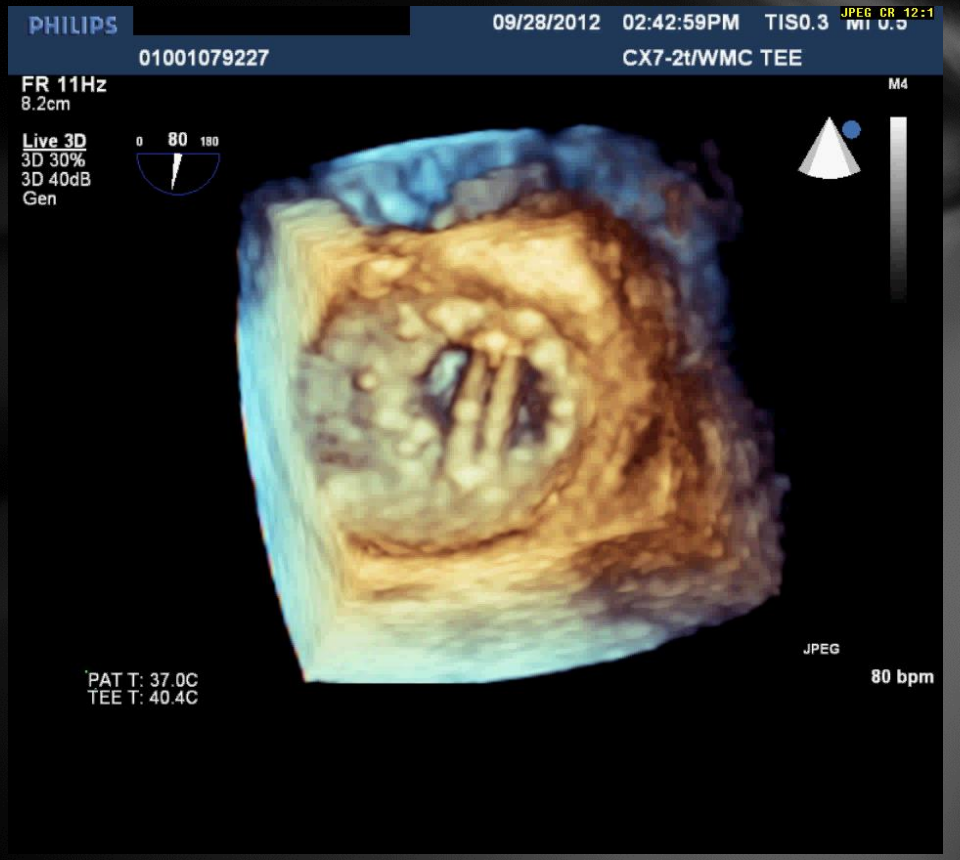


Mechanical MV Thrombosis: 3-D



Mechanical MV Thrombosis: Postop





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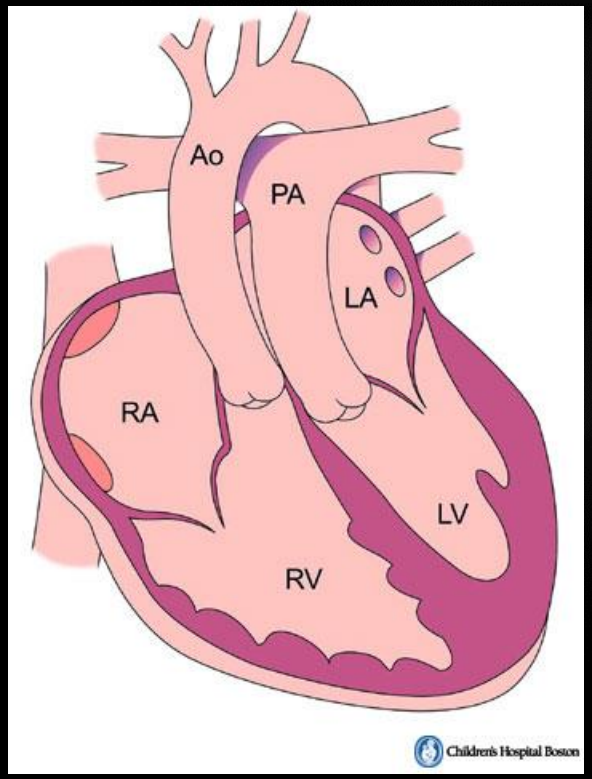
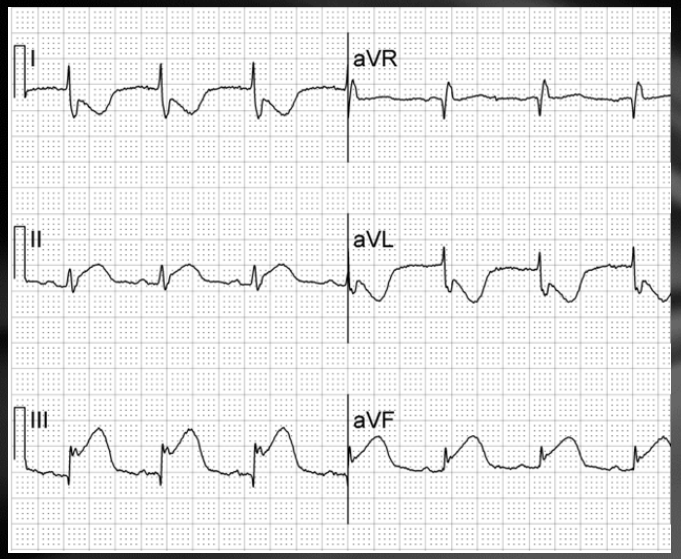
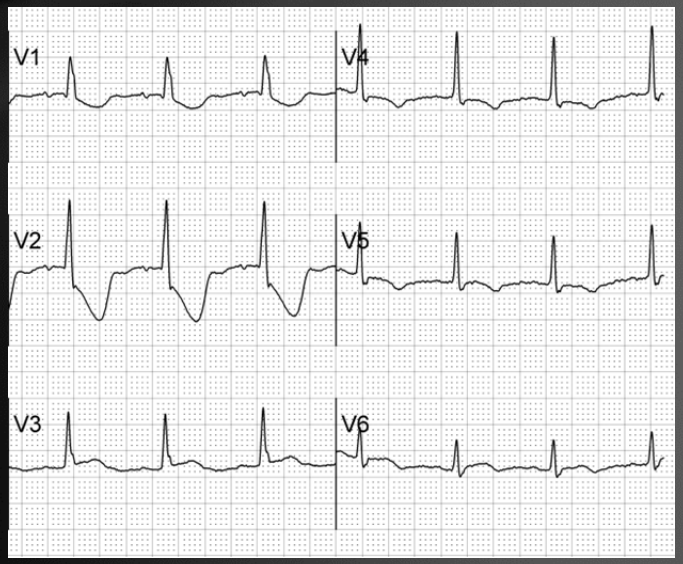
- Paradoxical Emboli
- Valvular Heart Disease
  - Mechanical prosthetic valve
  - Rheumatic mitral stenosis
  - Endocarditis
- **Dilated cardiomyopathy**
- Cardiac tumors

Cardiogenic Coronary Embolism:
38-year-old female with acute chest pain

- Transposition of the great vessels diagnosed at birth
- Mustard procedure at age 4







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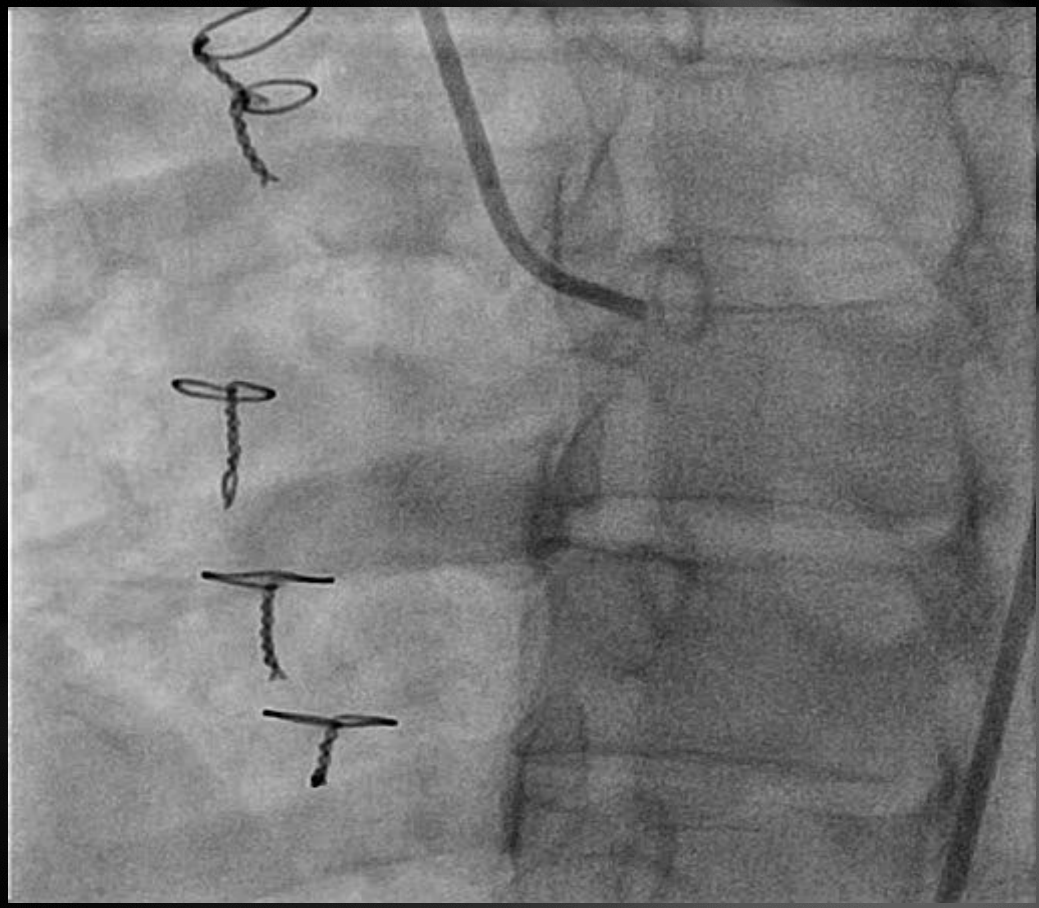
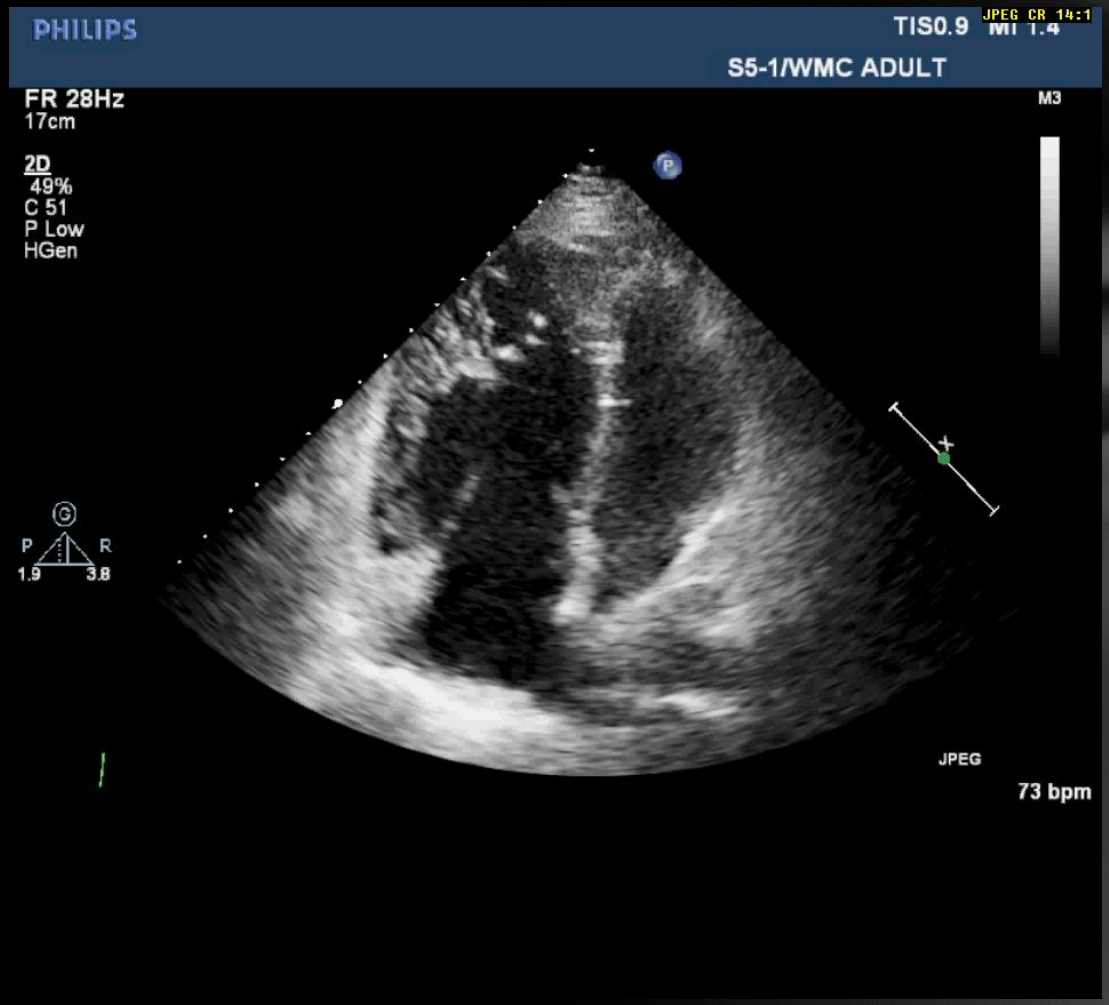
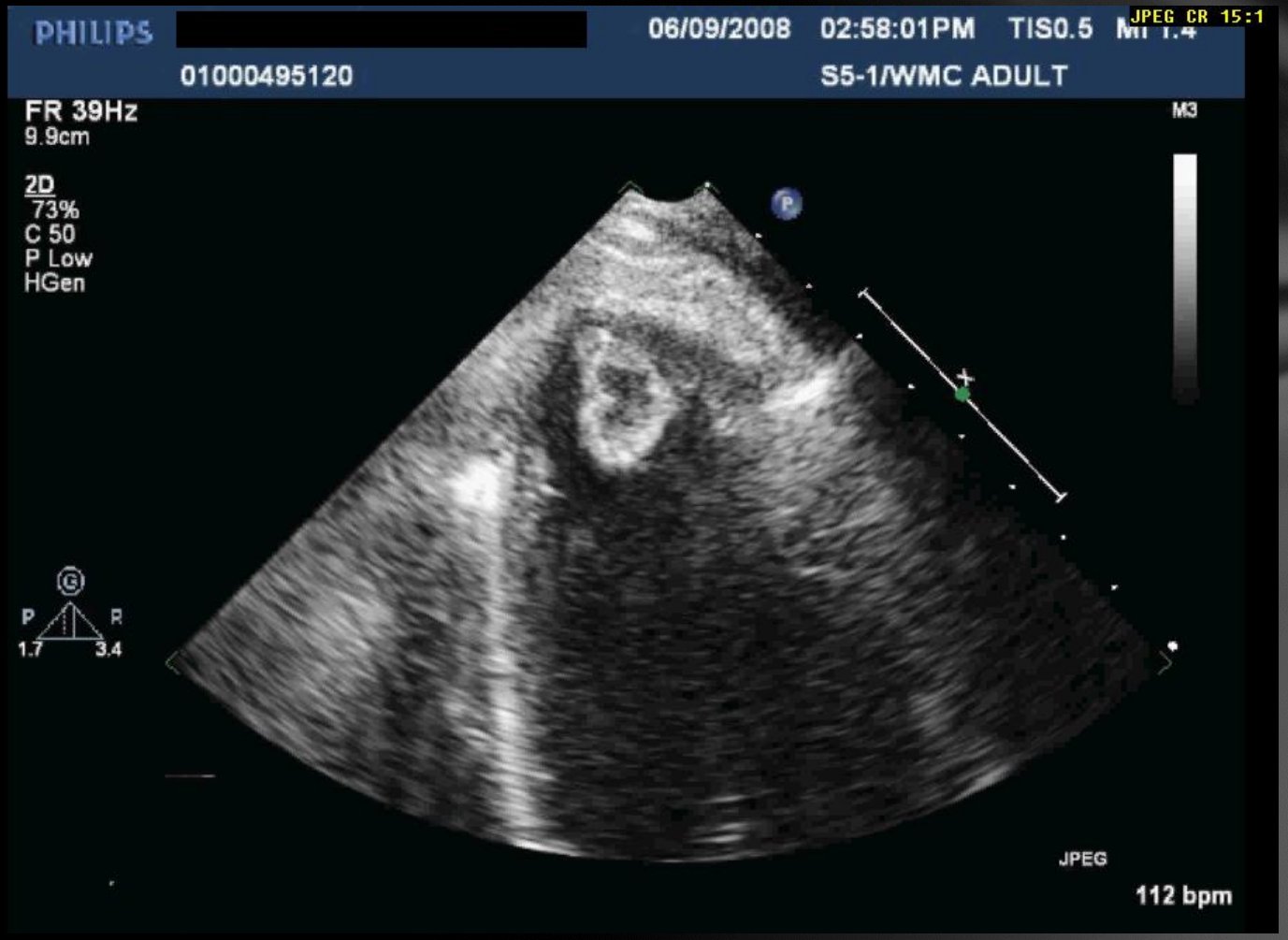


Cardiogenic Coronary Embolism:

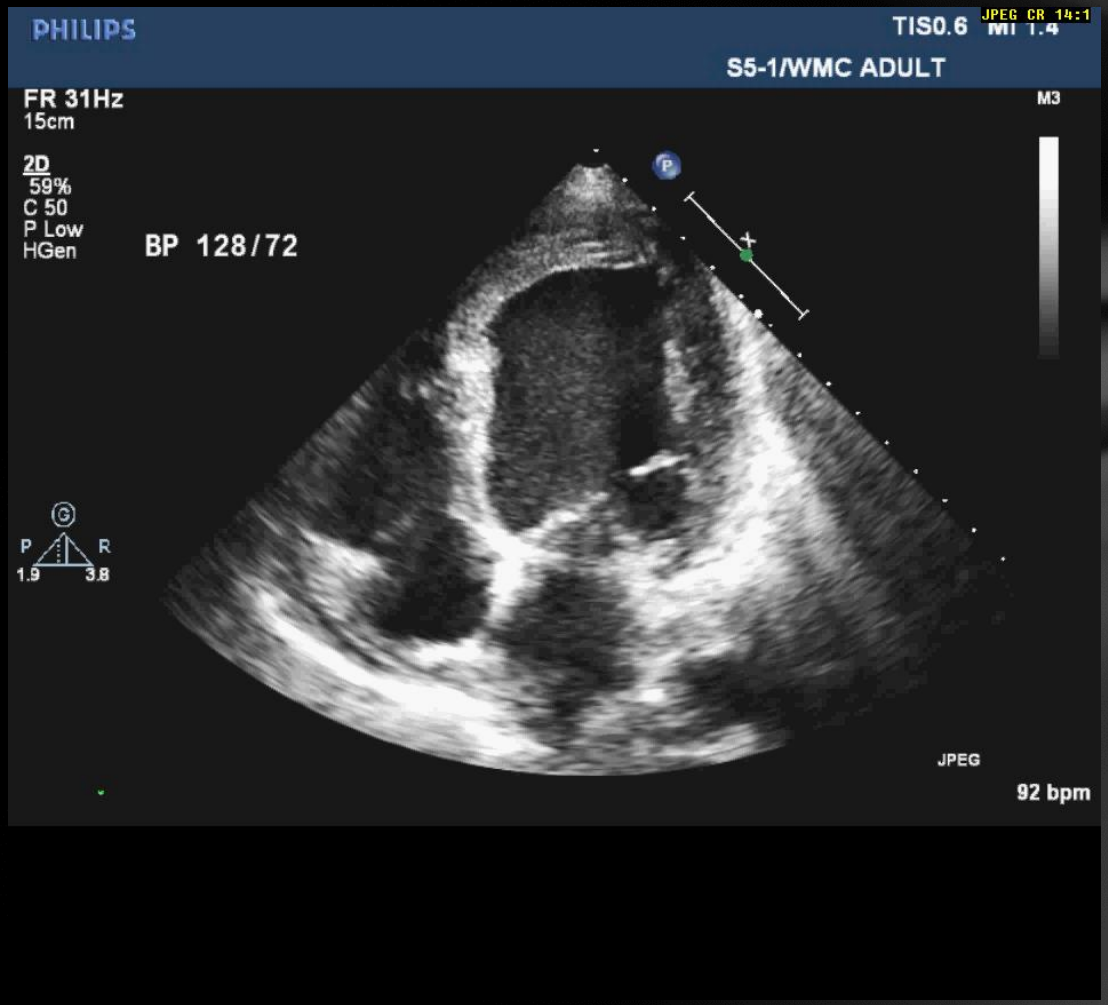
38-year-old female with acute chest pain



Dilated Cardiomyopathy



Dilated Cardiomyopathy: Layered Apical Thrombus



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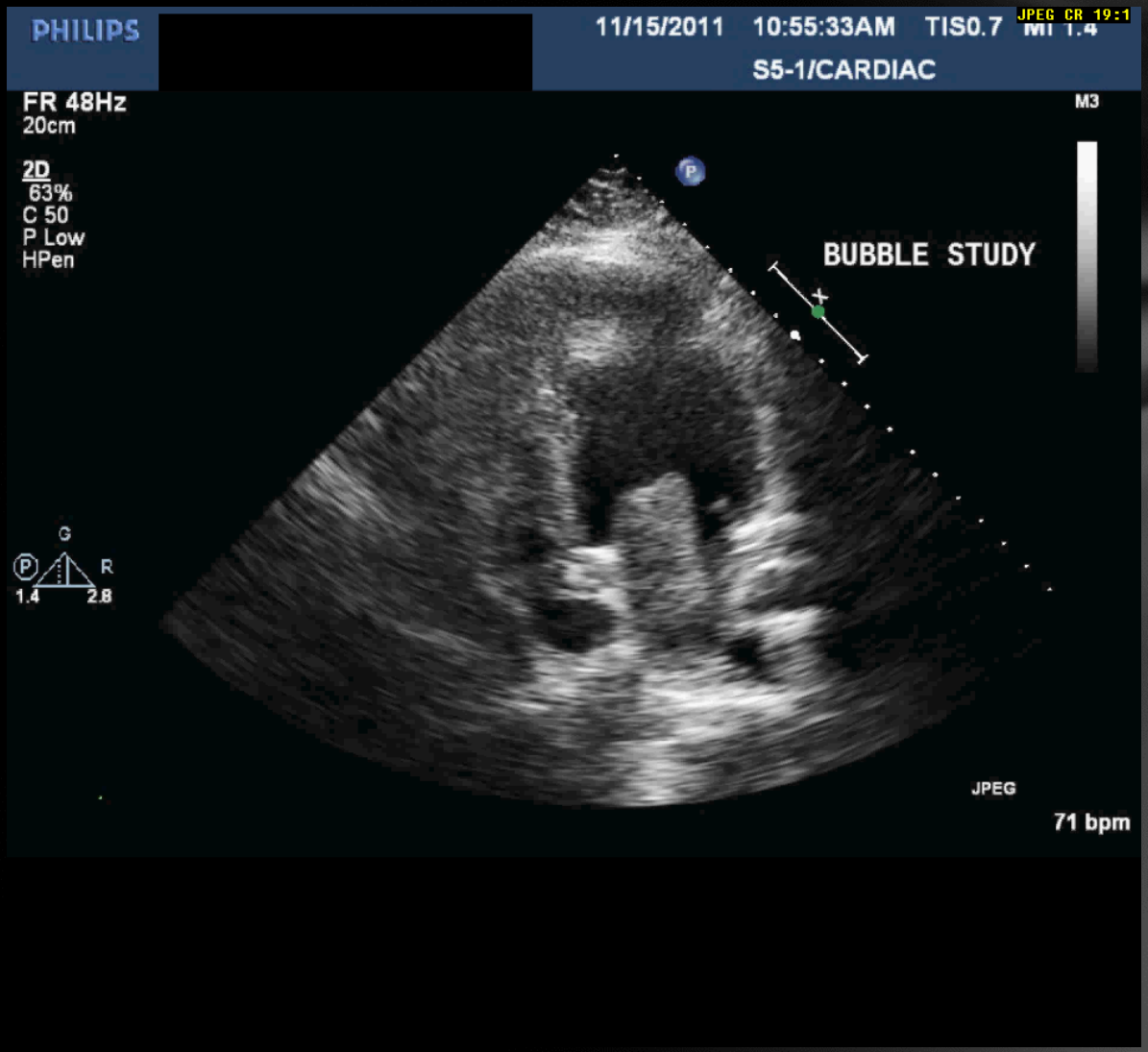
- Paradoxical Emboli
- Valvular Heart Disease
  - Mechanical prosthetic valve
  - Rheumatic mitral stenosis
  - Endocarditis
- Dilated cardiomyopathy
- **Cardiac tumors**

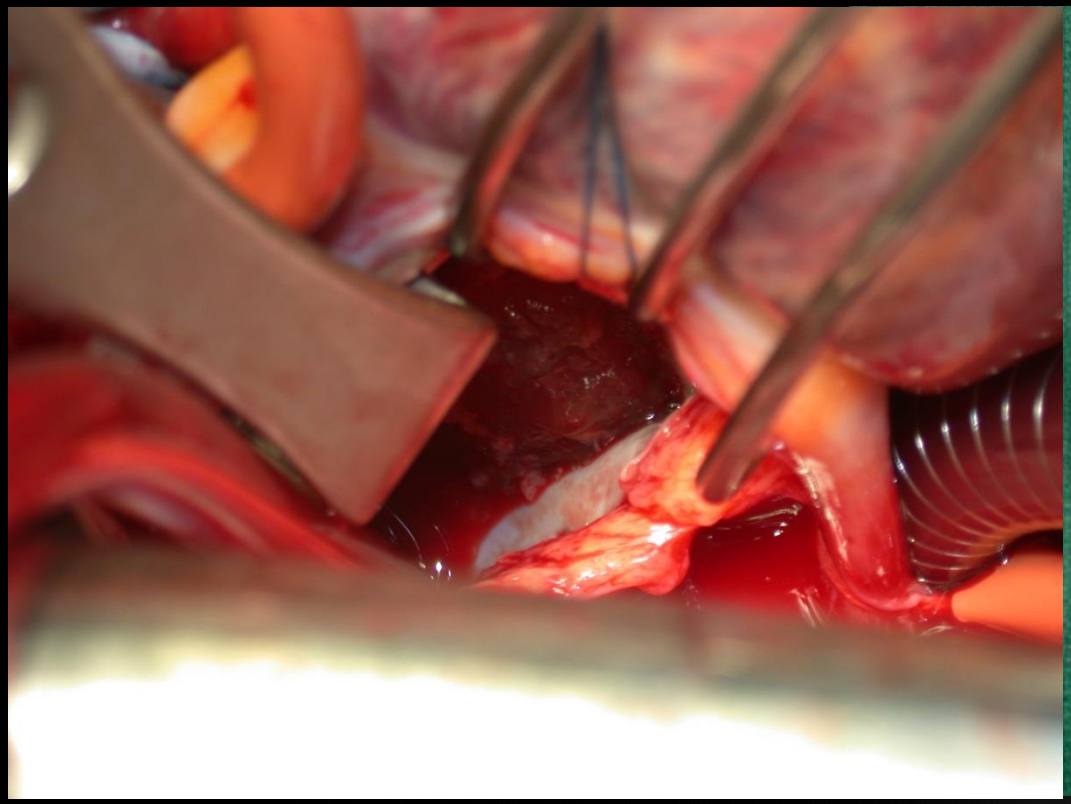
Atrial Myxomas: Symptoms related to embolization

- CNS Embolization:
  - In an review of 113 cases of atrial myxoma with neurologic presentation:
    - 83% of patients presented with ischemic stroke, most often in multiple sites (43%).
    - 12% of patients presented with seizures
  - In a retrospective review of 74 patients with atrial myxoma
    - 12% had neurologic manifestations.
      - Cerebral infarction was present in 89% of the cases and most myxomas (89%) demonstrated a mobile component on transesophageal echocardiography.
  - Other complications
    - Myxoma-induced cerebral aneurysm
    - Myxomatous metastasis mimicking vasculitis or endocarditis.

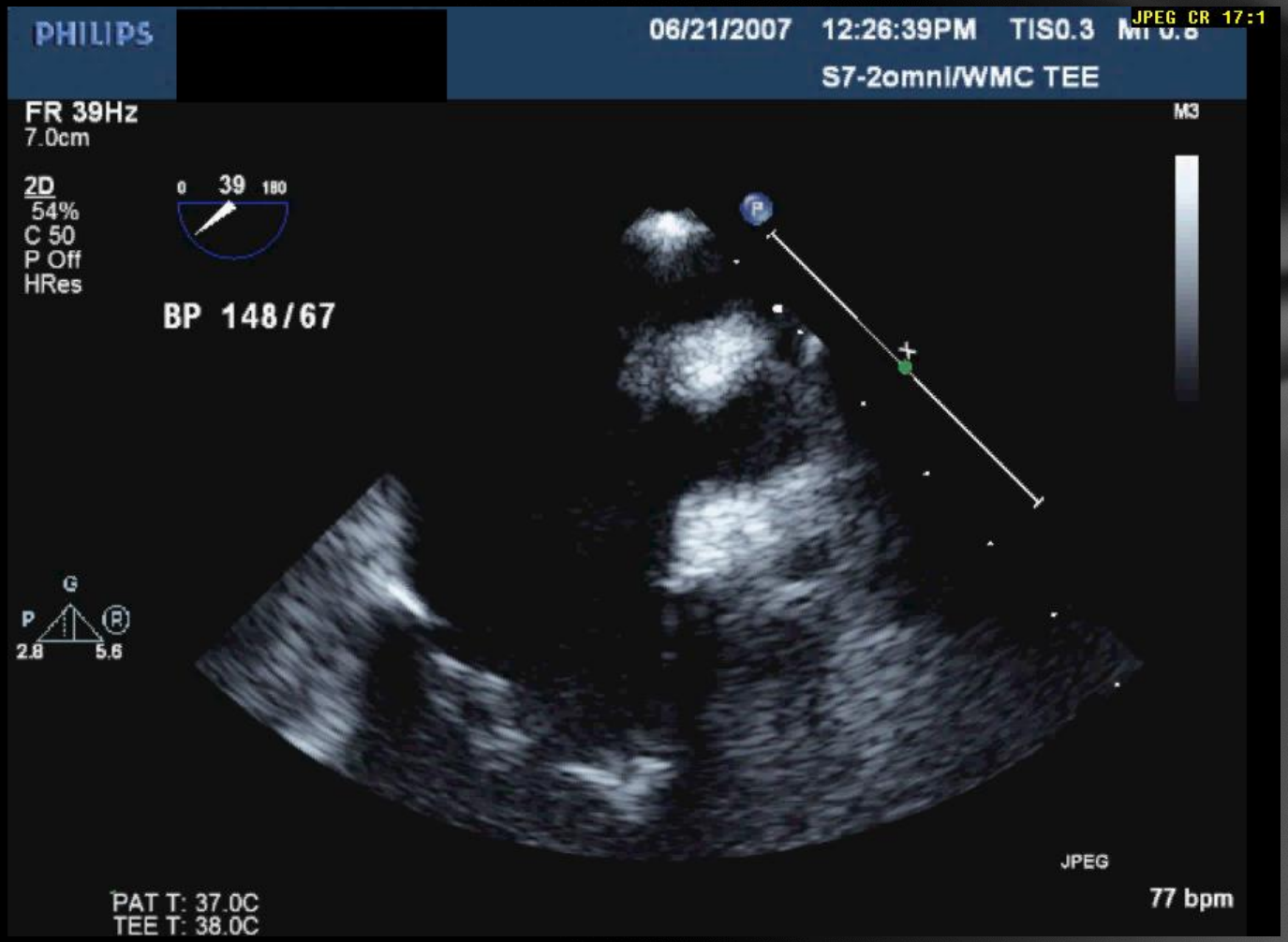
32 year-old Woman with Simultaneous TIA's and NSTEMI



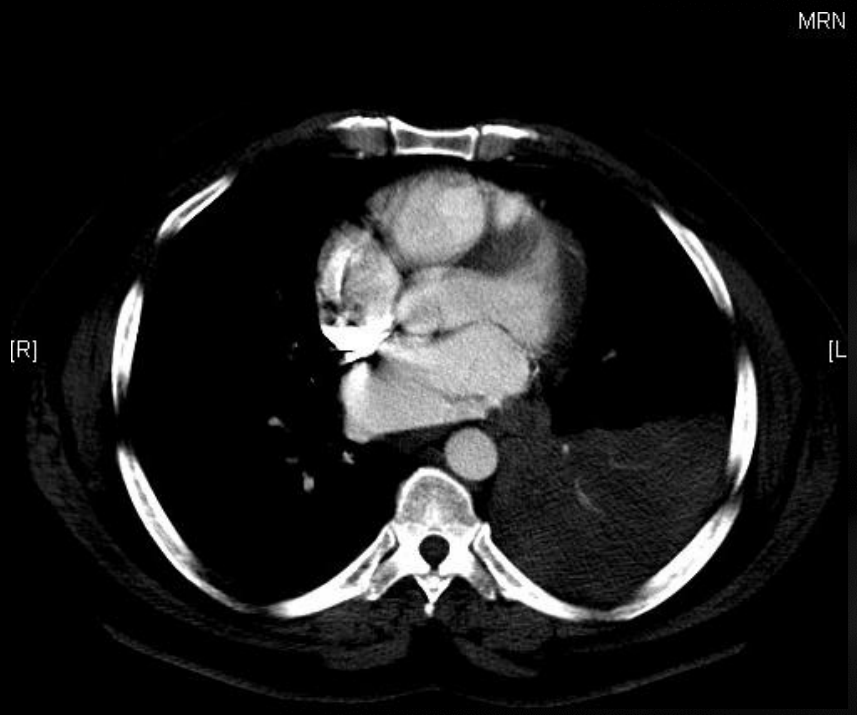
32 year-old Woman with Simultaneous TIA's and NSTEMI

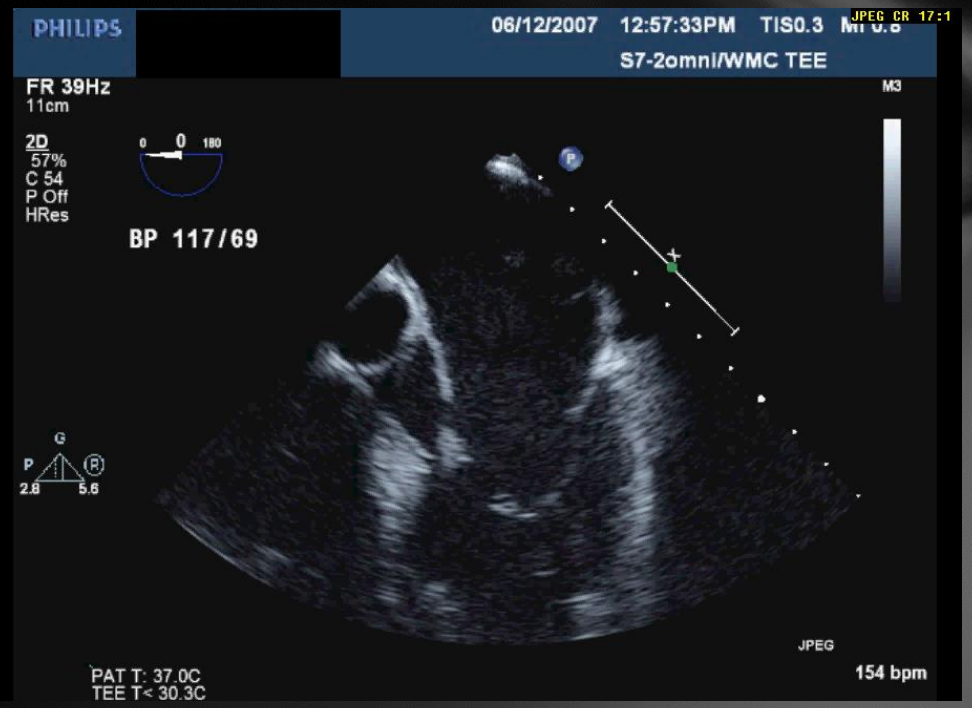


62 year4-old woman with stroke Negative TTE

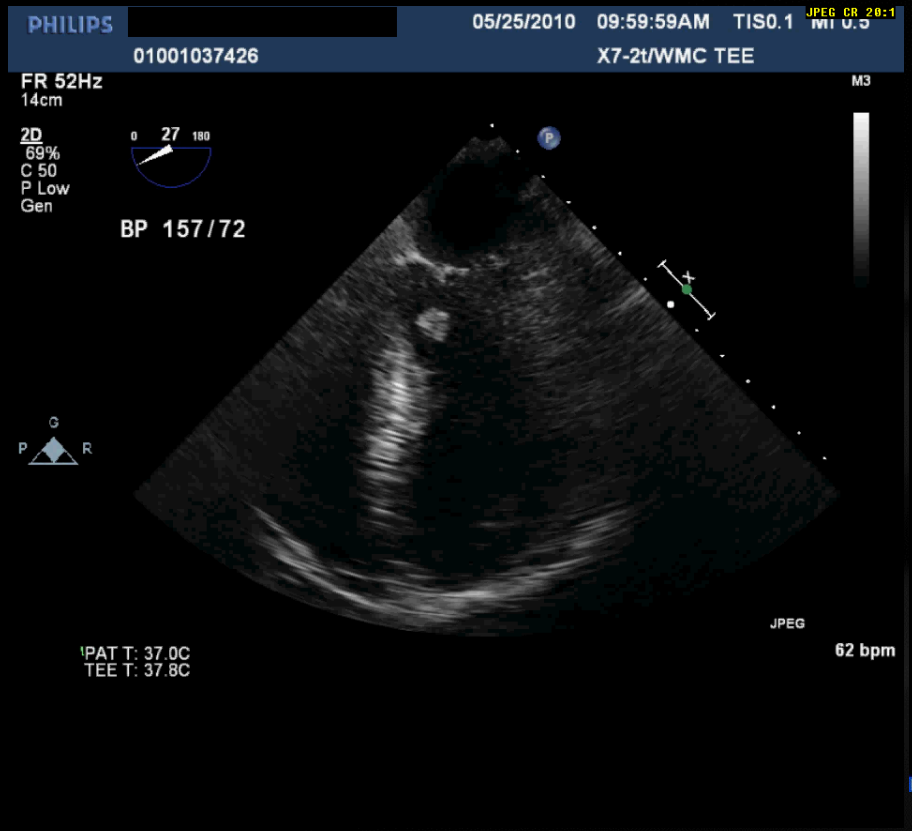


Metastatic Lung Cancer

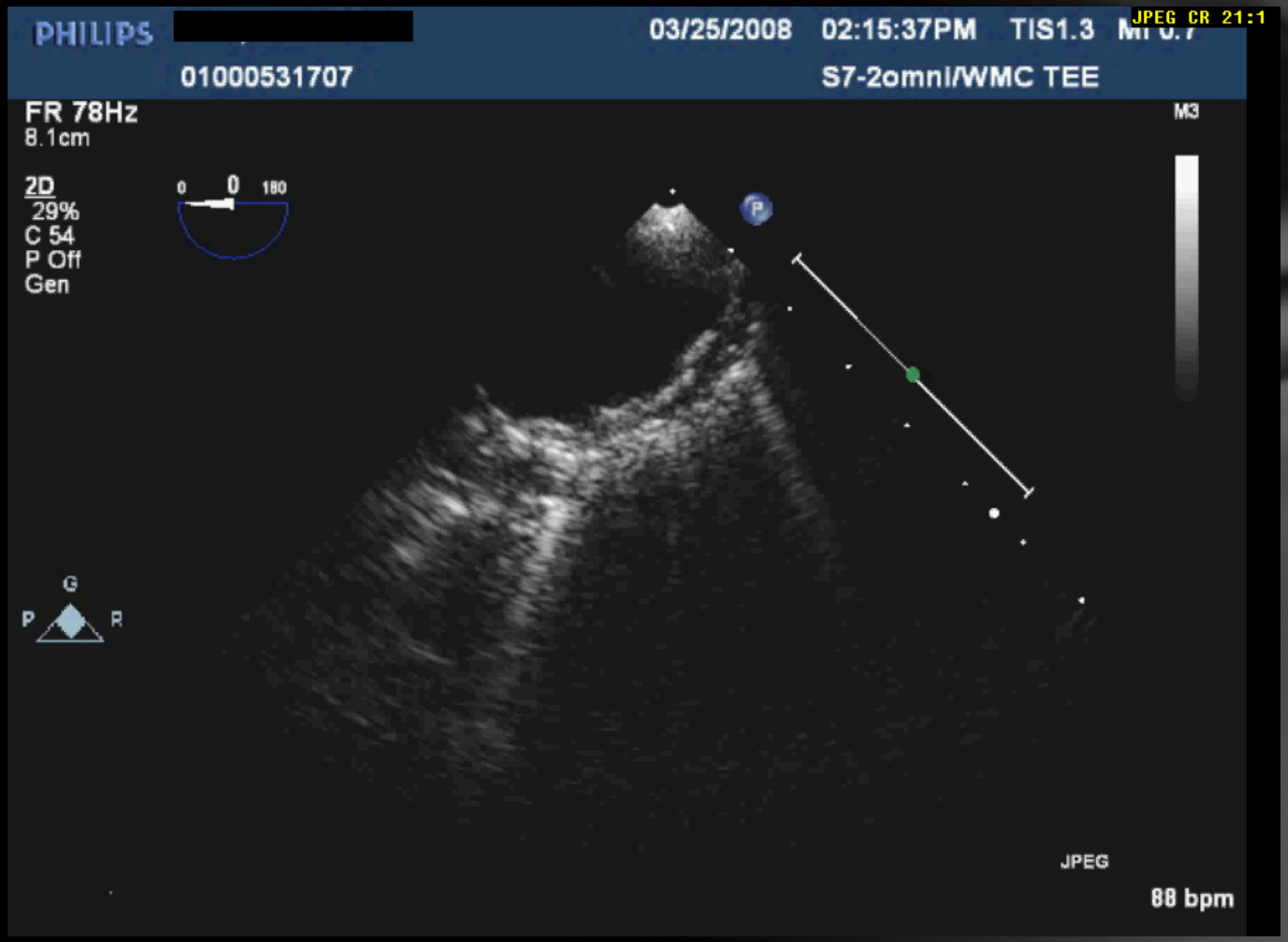




Left Ventricular mass: TEE

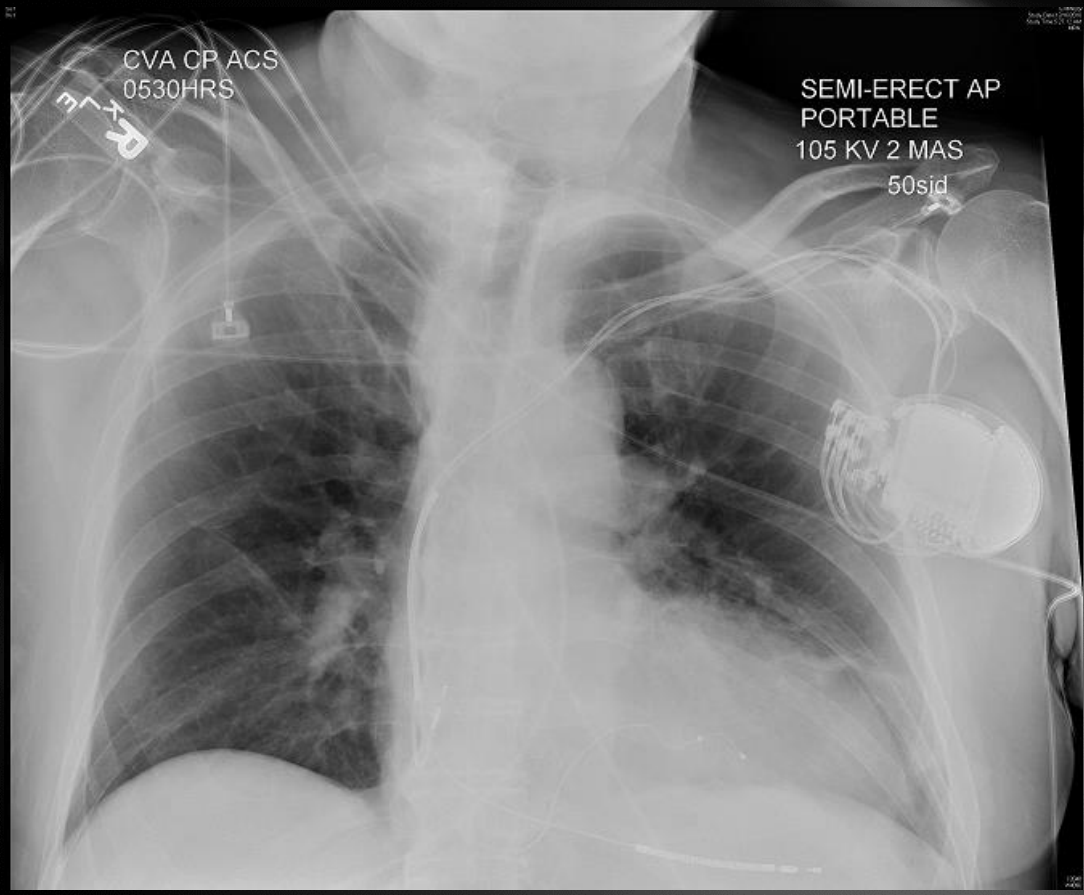


Mobile Aortic Atheroma

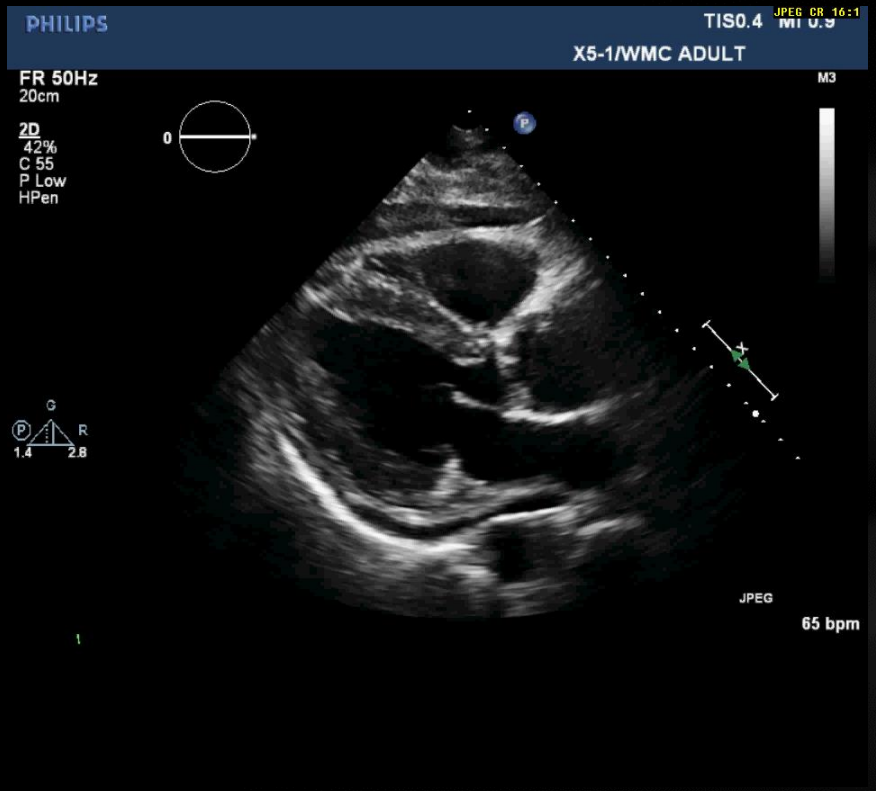


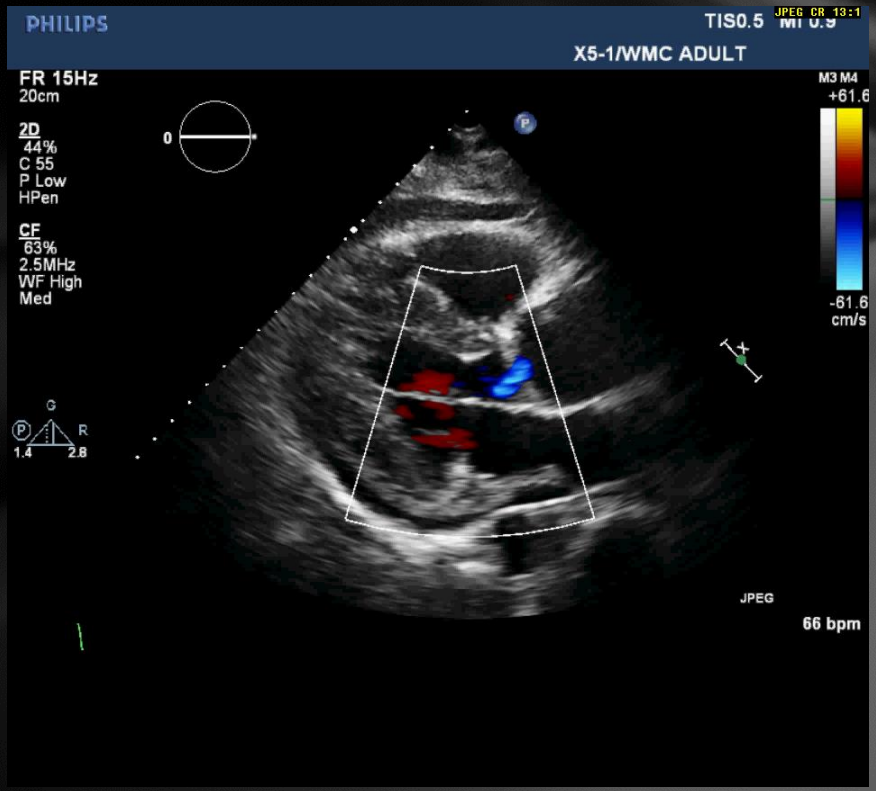
79-year-old male with Stroke Symptoms

- Nonischemic cardiomyopathy (EF 20%) – moderate CAD
- Class III congestive heart failure, biventricular ICD
- Sudden onset:
  - Confusion
  - weakness
  - Diaphoresis
  - Dizziness
  - Left-sided facial droop
  - Shortness of breath
  - Precordial chest pressure



79-year-old male with Stroke Symptoms



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