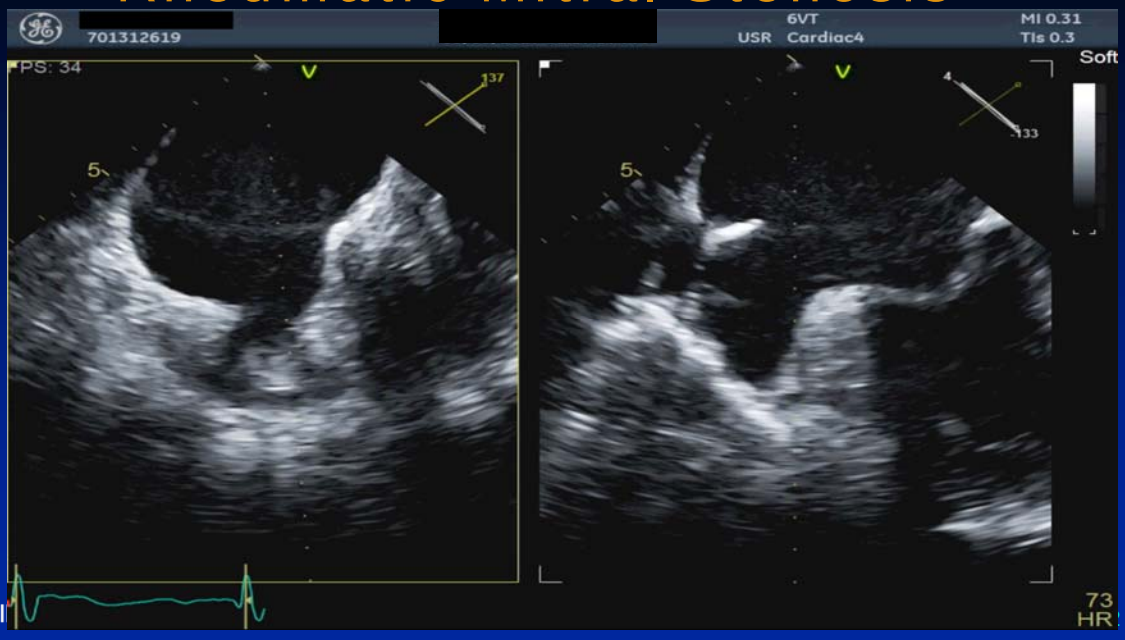
EVALUATION OF the LEFT ATRIAL APPENDAGE
Thrombus and Spontaneous Contrast

No disclosures related to this presentation

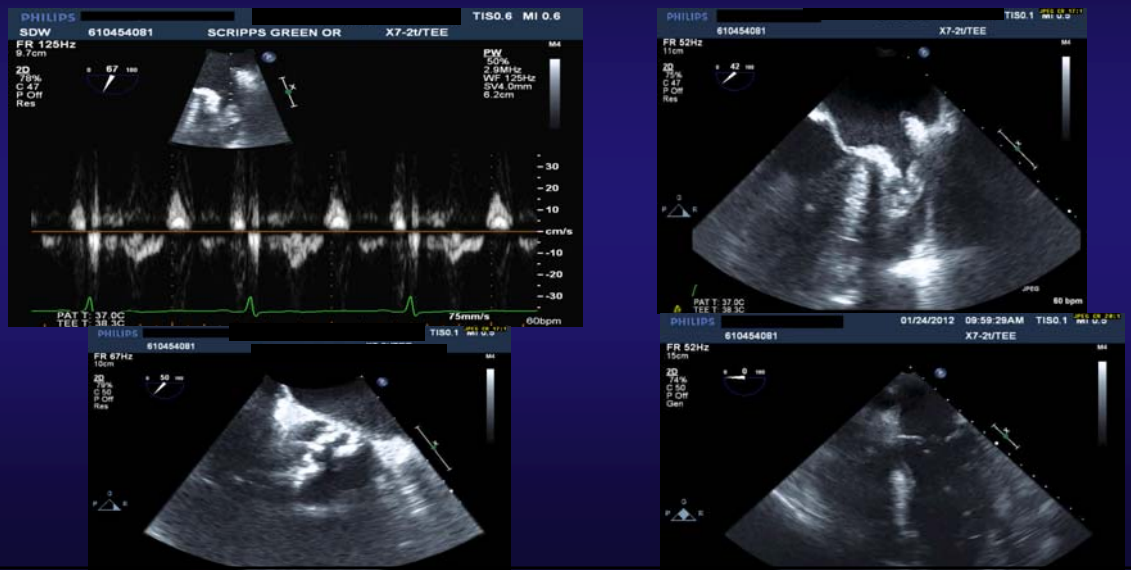
David S. Rubenson MD

Scripps Clinic Medical Group

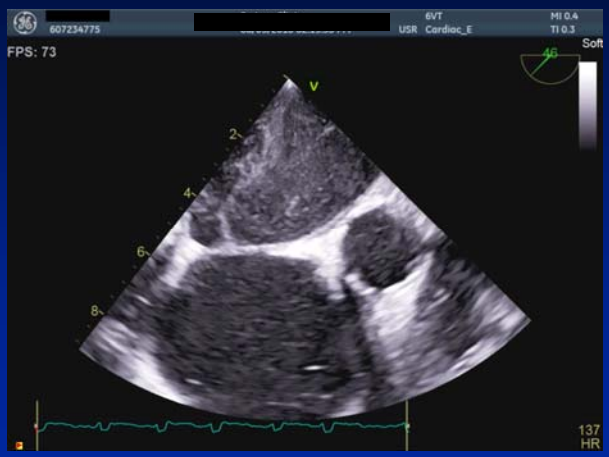
Rheumatic Mitral Stenosis



INCIDENTAL FINDING
Intra op TEE pre AVR/CABG



86 y/o female presenting for a pre Watchman evaluation has permanent AF, hx GI bleedng and is very frail with falling episodes. What would be the best descriptor for the finding shown ?



1. "Faint" LAA sludge
2. "Dense" LAA sludge and thrombus
3. Severe LAA spontaneous echo contrast
4. Left atrial myxoma
5. Mitral valve obstruction with slow forward flow

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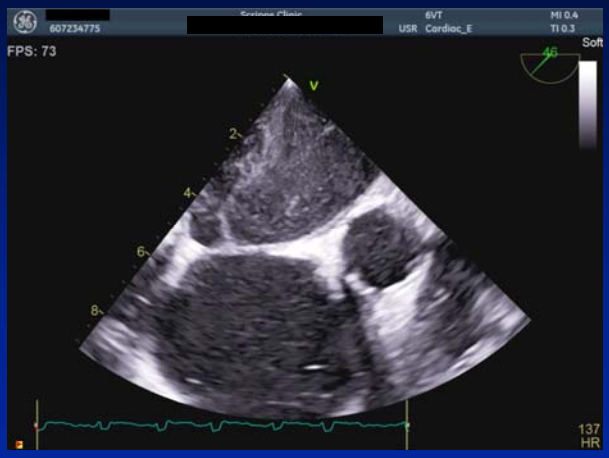
number 4

86 y/o female presenting for a pre Watchman evaluation has permanent AF, hx GI bleedng and is very frail with falling episodes. What would be the best descriptor for the finding shown ?



1. "Faint" LAA sludge
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number 5

Why is discussion of the LAA important?

- AF occurs in 0.4-1% of the USA population
  - >8% in those >80 years of age
  - Prevalence projected to double by 2035
- Thrombi form in the LA in the presence of AF
  - Reduced contractility and stasis
- Frequent need to assess risk
  - Stroke – frequent association with AF (unrecognized)
  - Pre Cardioversion
  - During interventional transcath procedures

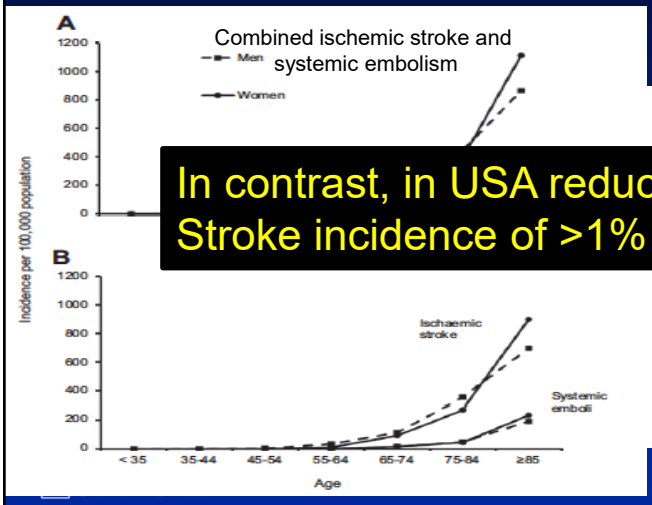
SCRIPPS CLINIC

number 6

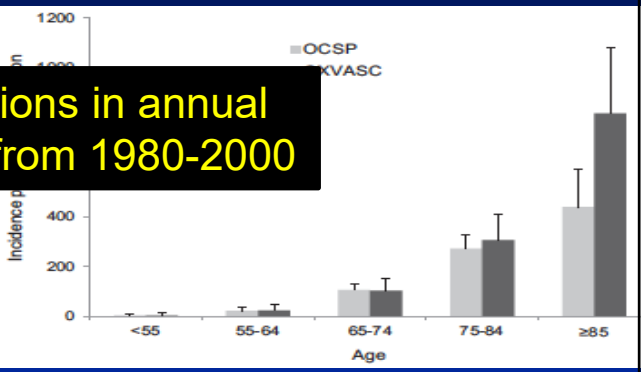
Age-Specific Incidence, Outcome, Cost, and Projected Future Burden of Atrial Fibrillation–Related Embolic Vascular Events

A Population-Based Study

Circ 2014;130:1236

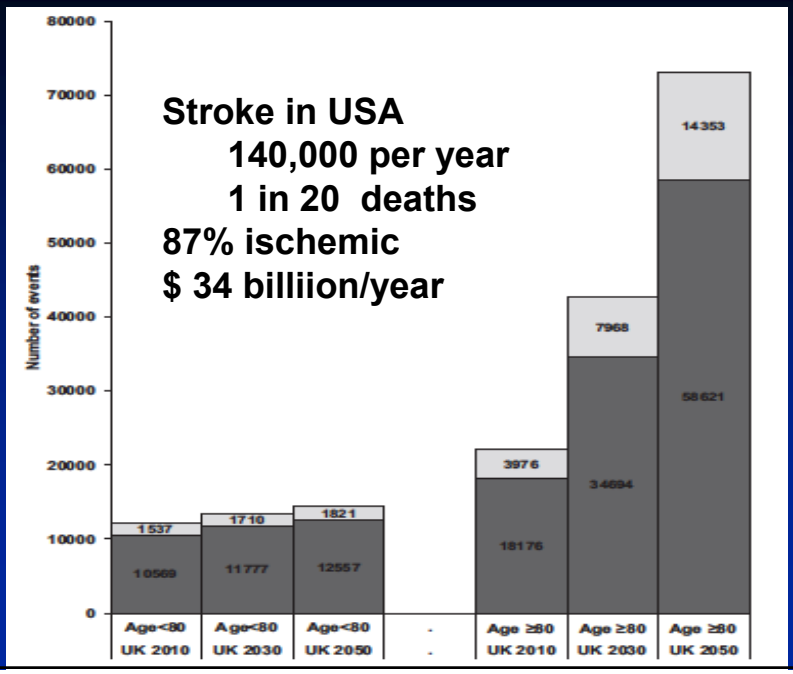


In contrast, in USA reductions in annual Stroke incidence of >1% from 1980-2000



number 7

PROJECTION TO YEAR 2050



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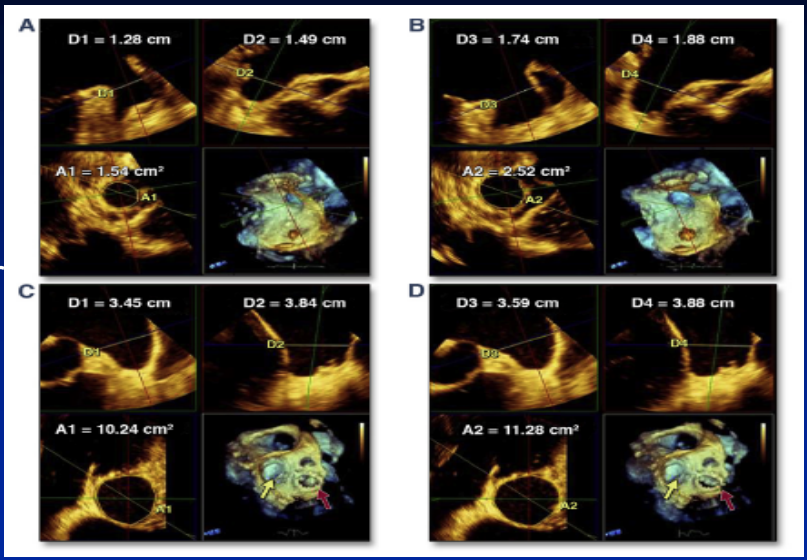
number 8

Effects of AF on Function predispose to Thrombus

- Decrease in contractility
- Dilation of the LAA
- Decrease in doppler velocities
- Minimal change in systole and diastole



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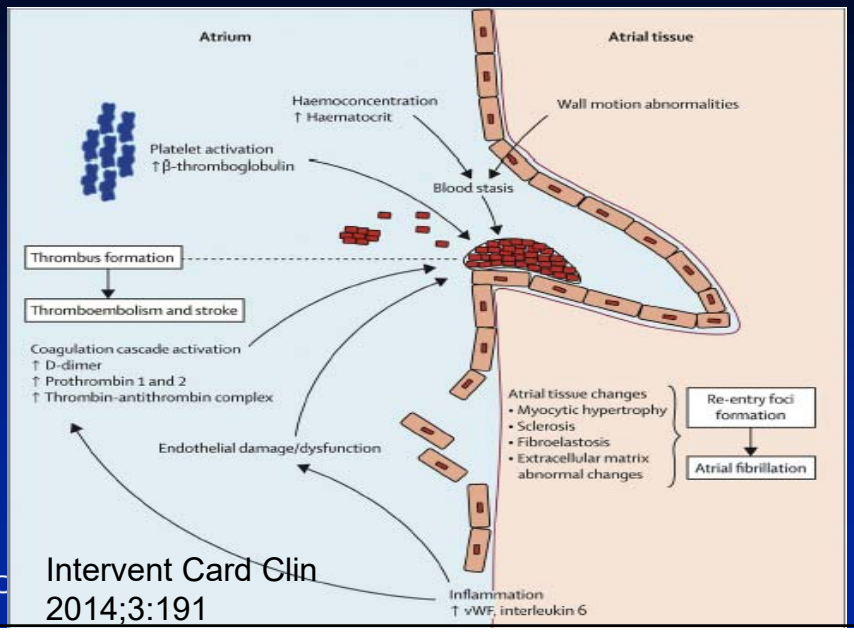
JACC IMAG 2014;7:1251

number 9

Factors involved in LAA thrombus formation



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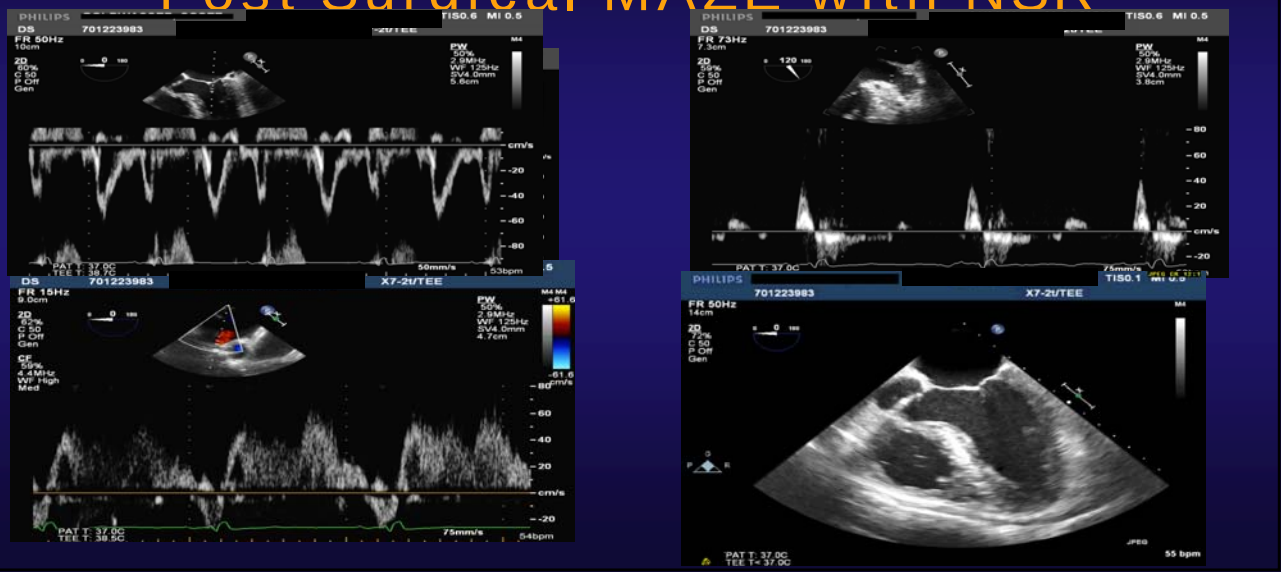
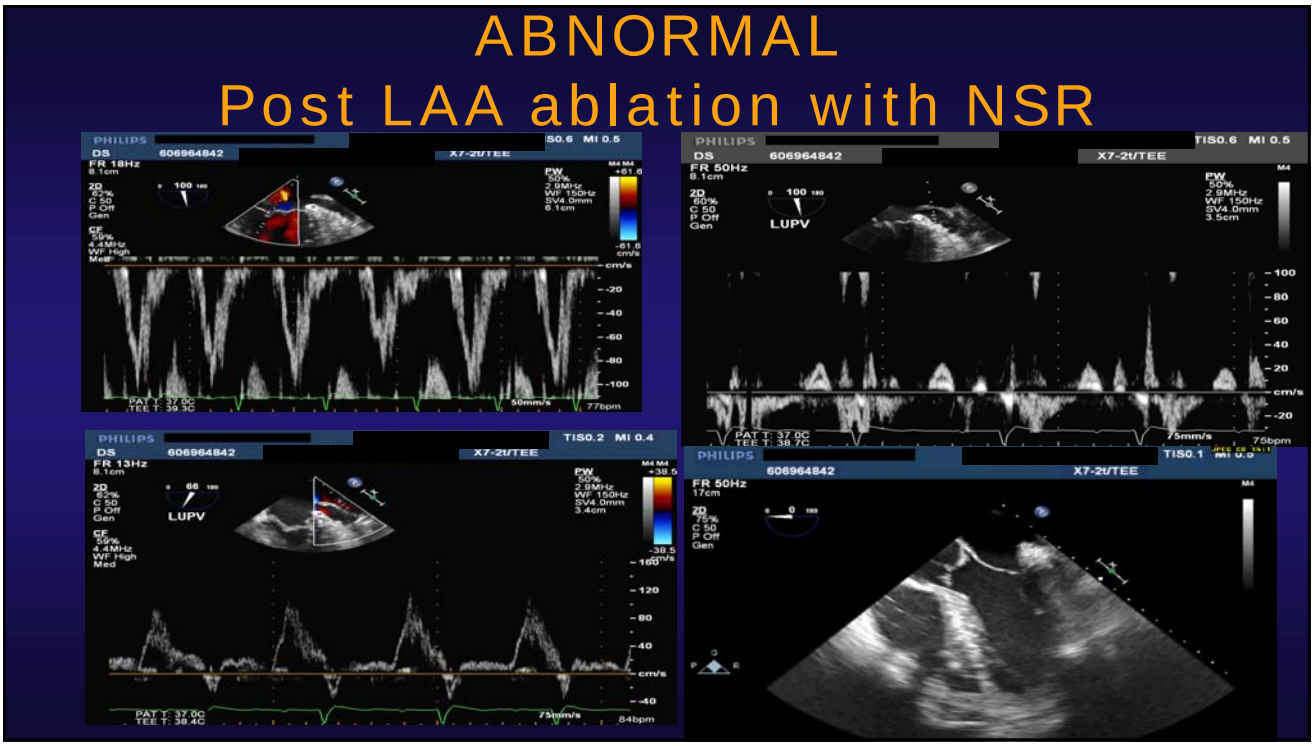
Intervent Card Clin 2014;3:191

number 10

LEFT ATRIAL MECHANICAL FUNCTION Post Surgical MAZE with NSR

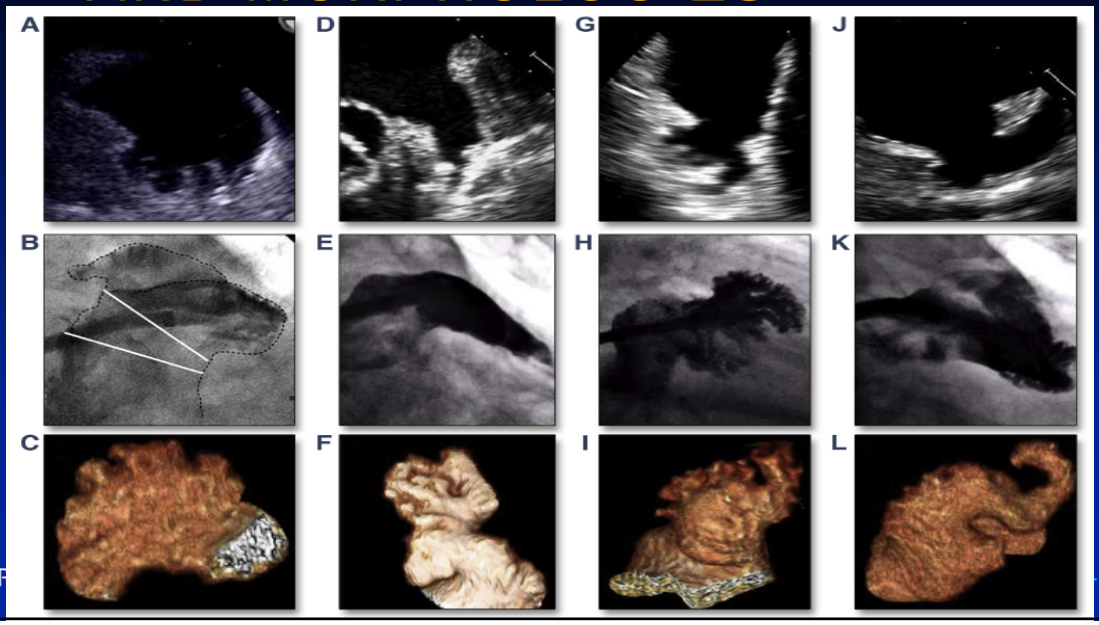


ABNORMAL Post LAA ablation with NSR



LAA ANATOMIC VARIANTS AND MORPHOLOGIES

JACC IMAG 2014 7:1251



Thrombus

- A powerful predictor of risk
- Stands as the only absolute contraindication to CDV
- Mandates anticoagulation therapy until resolution
- Data from multiple sources confirm the efficacy of risk reduction with warfarin and NOAC

THROMBUS

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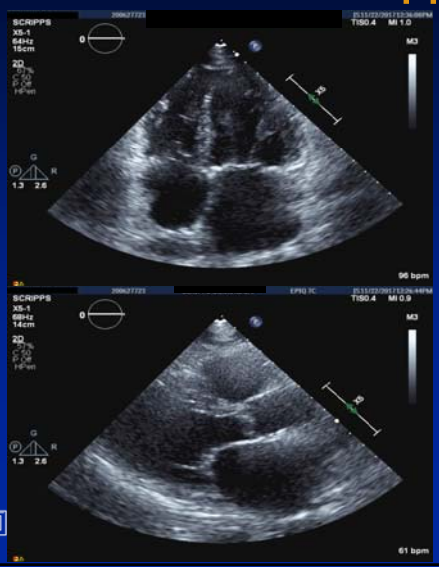
JACC IMAG 2014;7:1251

number 15

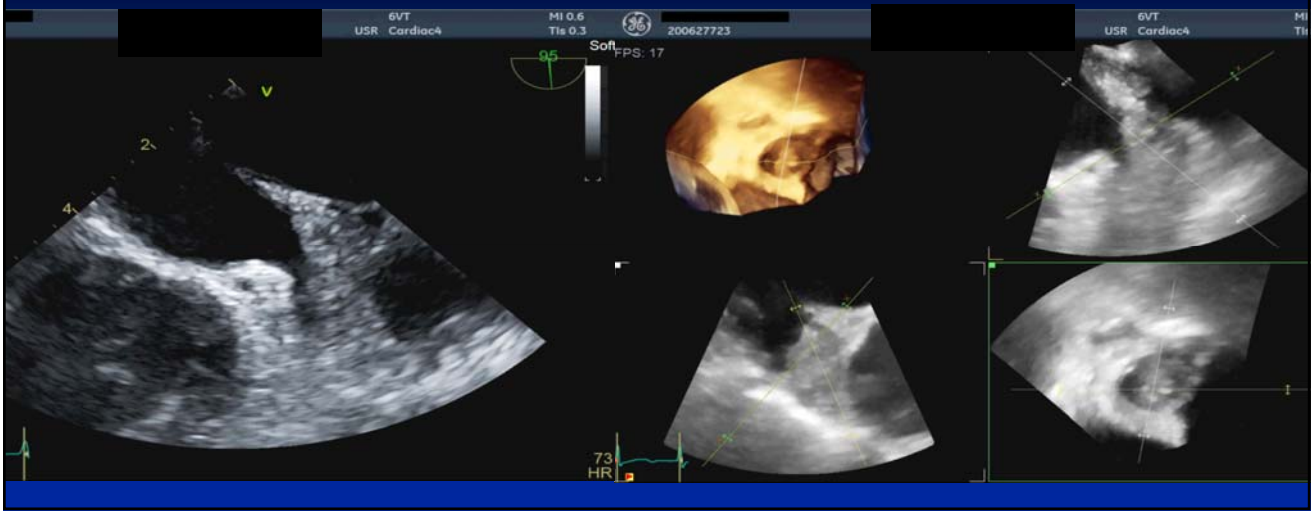
80 y/o healthy female
New AF with flu-like illness.
Hx HTN HLD



number 16

TEE pre CDV

Confirmation with MPR



Pre CVD TEE

1 Month oral anticoagulant

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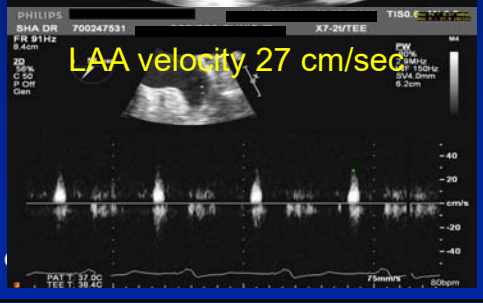
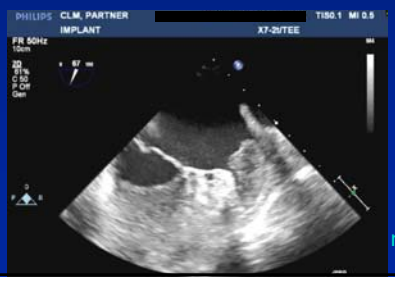
number 18

POST MVR with chronic AF
Inadequate anticoagulation

93 y/o male referred for TAVR
Low Flow Low Gradient AS with LVEF 40%



LAA velocity 27 cm/sec



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number 20

Pre TAVR Outpatient TEE
3 month F/U post OAC

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number 21

IMAGING TO DETECT LAA THROMBI

- ECHOCARDIOGRAPHY (TEE)
  - Sensitivity 92% Specificity 98%
  - Compared with intraop observation (Ann Int Med 1995)
- ECHO TECHNIQUES
  - 2D AND 3D Imaging in mutliple views
  - Multiplanar reconstruction
  - Ultrasound contrast
  - Spectral doppler velocities
  - Tissue dopper and strain
  - Intracardic echo - ? less sensitive

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number 22

LAA INTERIOR FINDINGS
Sources of Confusion

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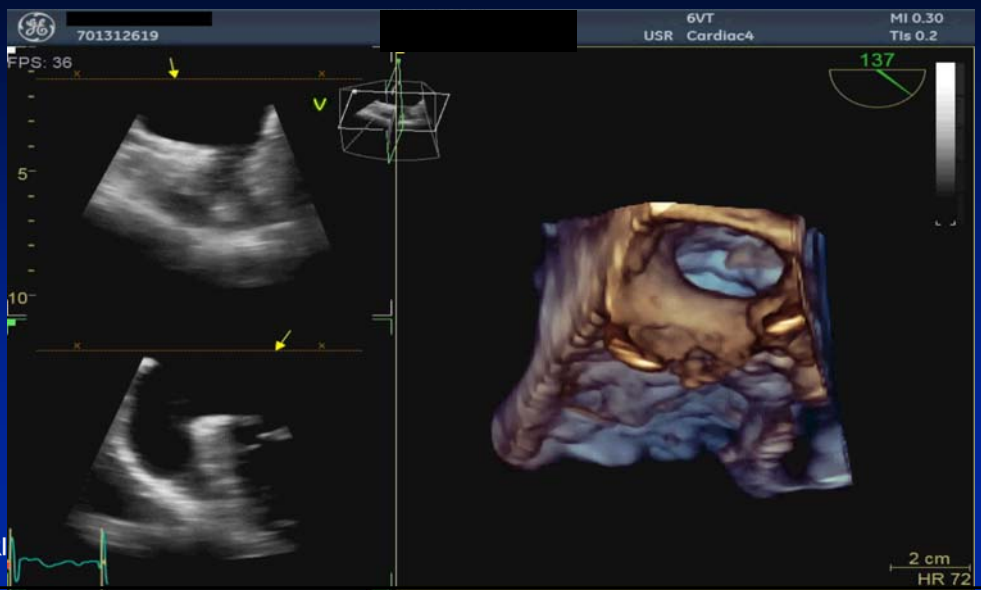
JACC IMAG 2014;7:1251

number 23

Application of 3D TEE



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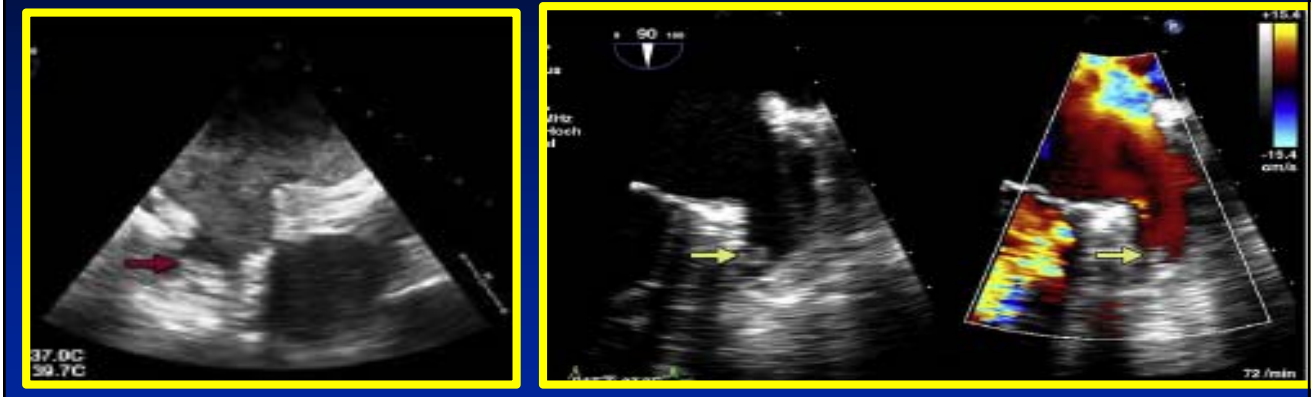
Use of Contrast and Color Doppler with Low Aliasing



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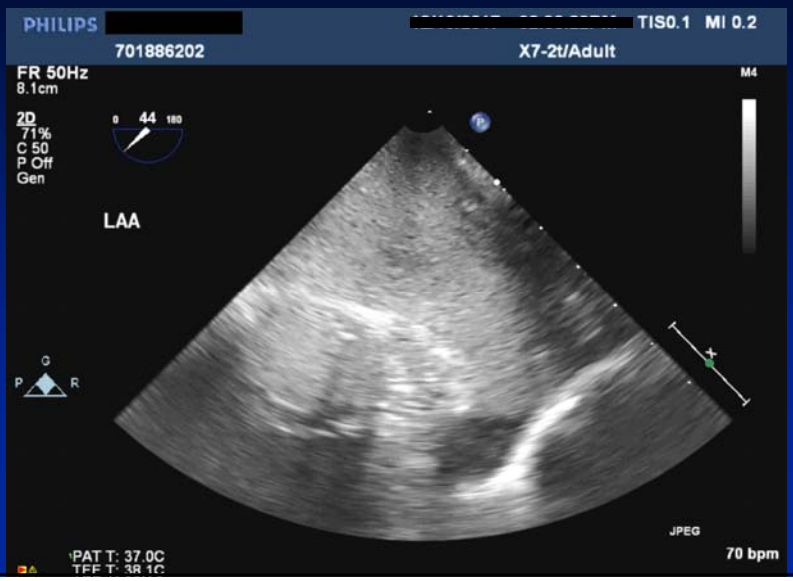
JACC IMAG 2014;7:1251

number 25

Use of echo contrast to confirm thrombus



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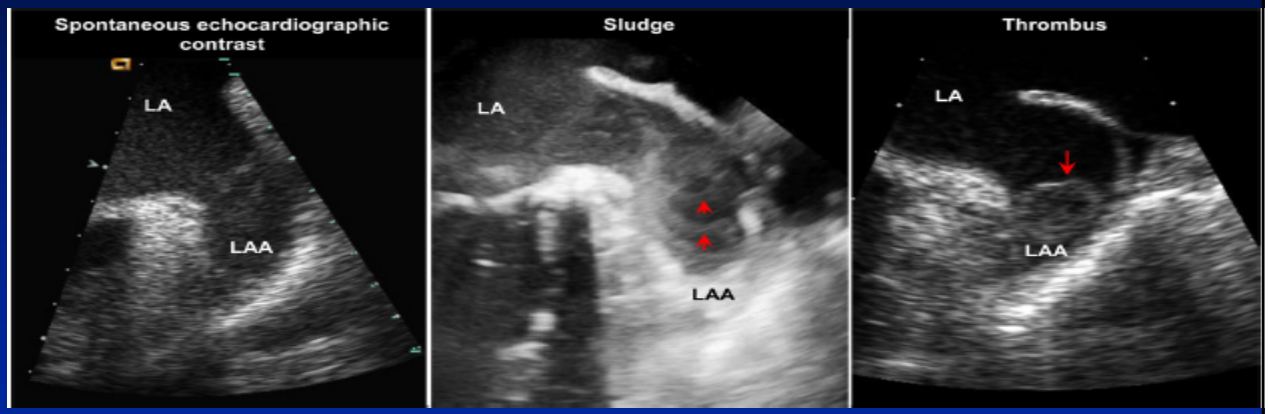
number 26

CLOUDINESS IN THE LA AND LAA DIFFERENTIATION

- **SPONTANEOUS ECHO CONTRAST**
  - Swirling echo density with the LA or LAA imaged with gain set to diminish background
  - Dense: continuously seen
  - Faint: intermittent
- **"SLUDGE"**
  - Viscous, gelatinous morphology without consistent form
- **THROMBUS**
  - Organized echo density with defined border, often oscillating

SCRIPPS CLINIC

number 27



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JASE 2014;27:1176

number 28

SEC and SLUDGE

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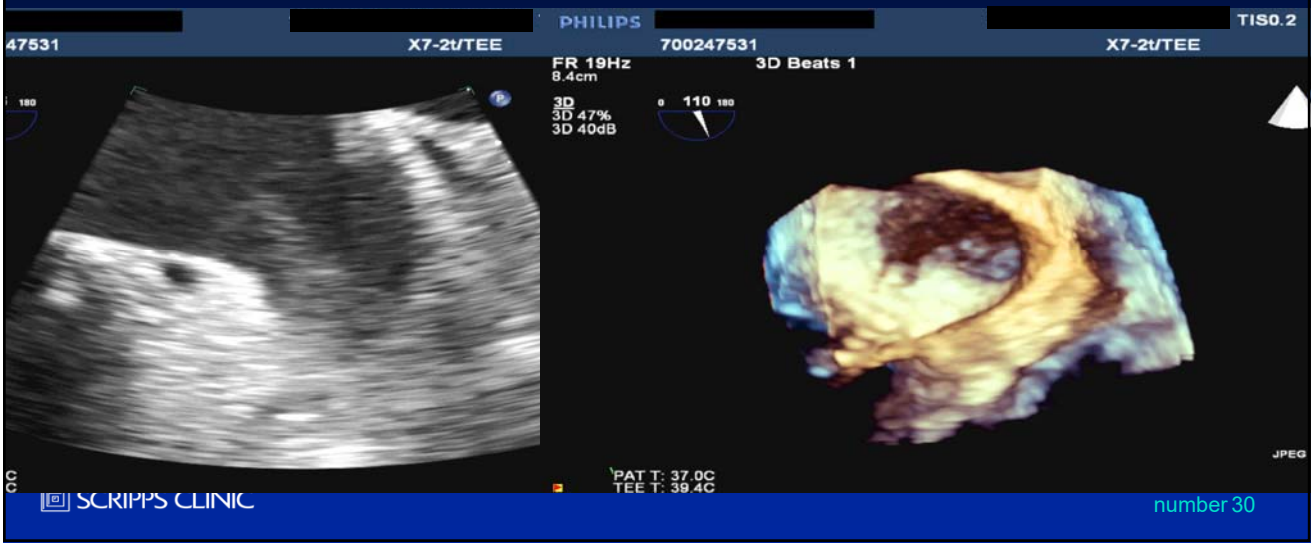
JACC IMAG 2014;7:1251

number 29

Elderly male with reduced LVEF, AS and chronic AF post PPM



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number 30

Clinical Significance of SEC

- Found in 12-67% of AF patients
- Associated with clinical predictors of stroke
  - Older age, previous thromboembolism,HTN, constant AF
  - Larger LA and LAA size and volumes
  - Lower LA emptying velocities (<20 cm/sec)
  - Presence of LAA thrombus
- Dense SEC without anticoagulation
  - 3X greater rate of stroke

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number 31

SEC: Studies on Anticoagulated Patients

- SPAF (Ann Int Med 1998)
  - TEE evaluation 382 hi risk AF patients
  - 63% SEC (20% dense)
  - Median INR 2.3
  - Stroke rate: Faint SEC 2.8%, Dense SEC 4.5%
- Bonn Study (JACC 2005)
  - Serial TEE, neurology and MRI exams
  - 128 permanent AF patients : dense SEC
  - On warfarin with mean INR 2.3 (31% suboptimal)
  - Thromboembolic events 23%
    - 3pts (2%) cerebral embolism with neuro deficits
    - 8pts (6%) died due to embolic events
    - 19pts (15%) silent embolism on MRI

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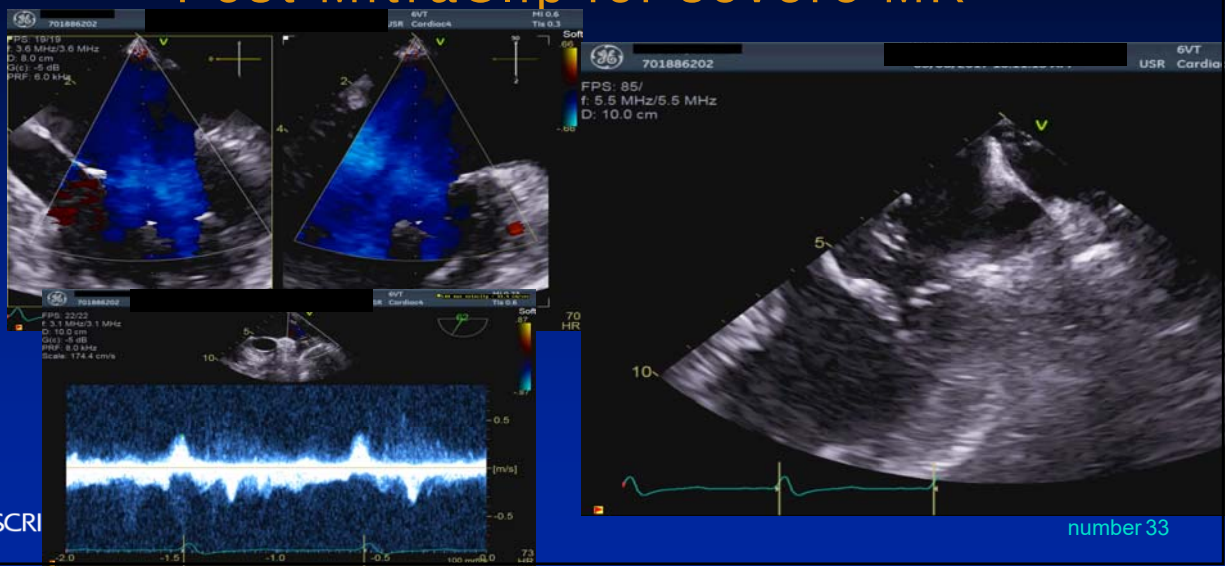
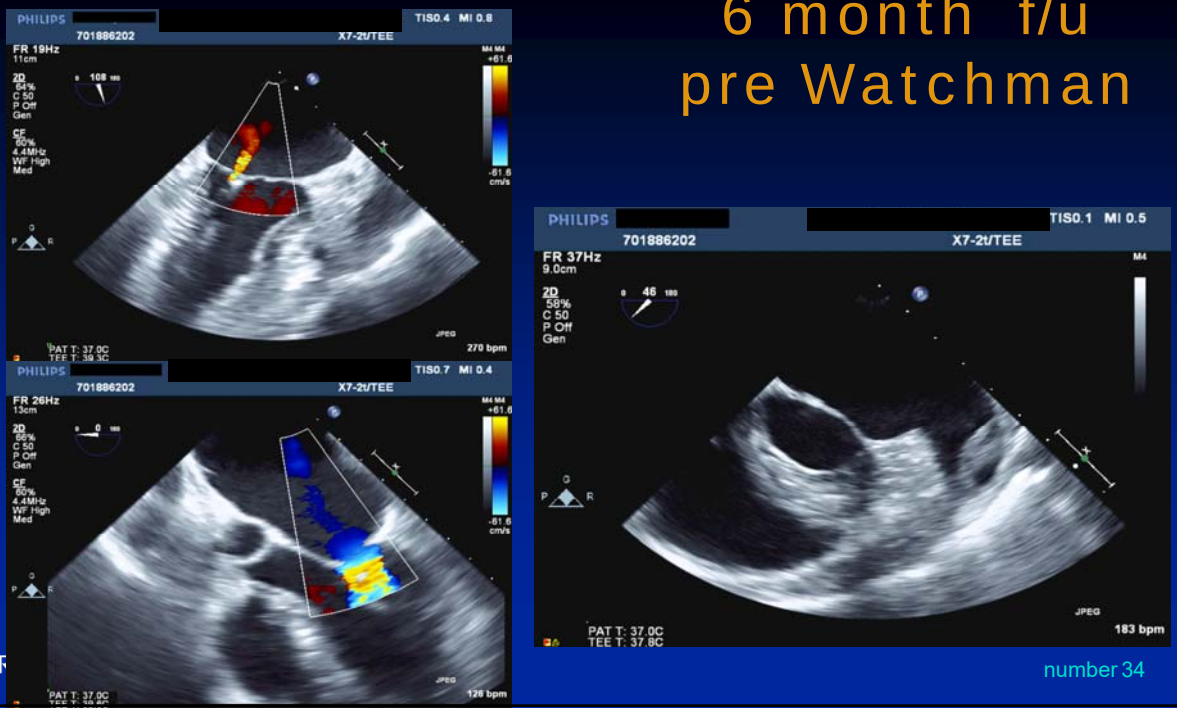
number 32

SEC developing into thrombus despite OAC Post MitraClip for severe MR

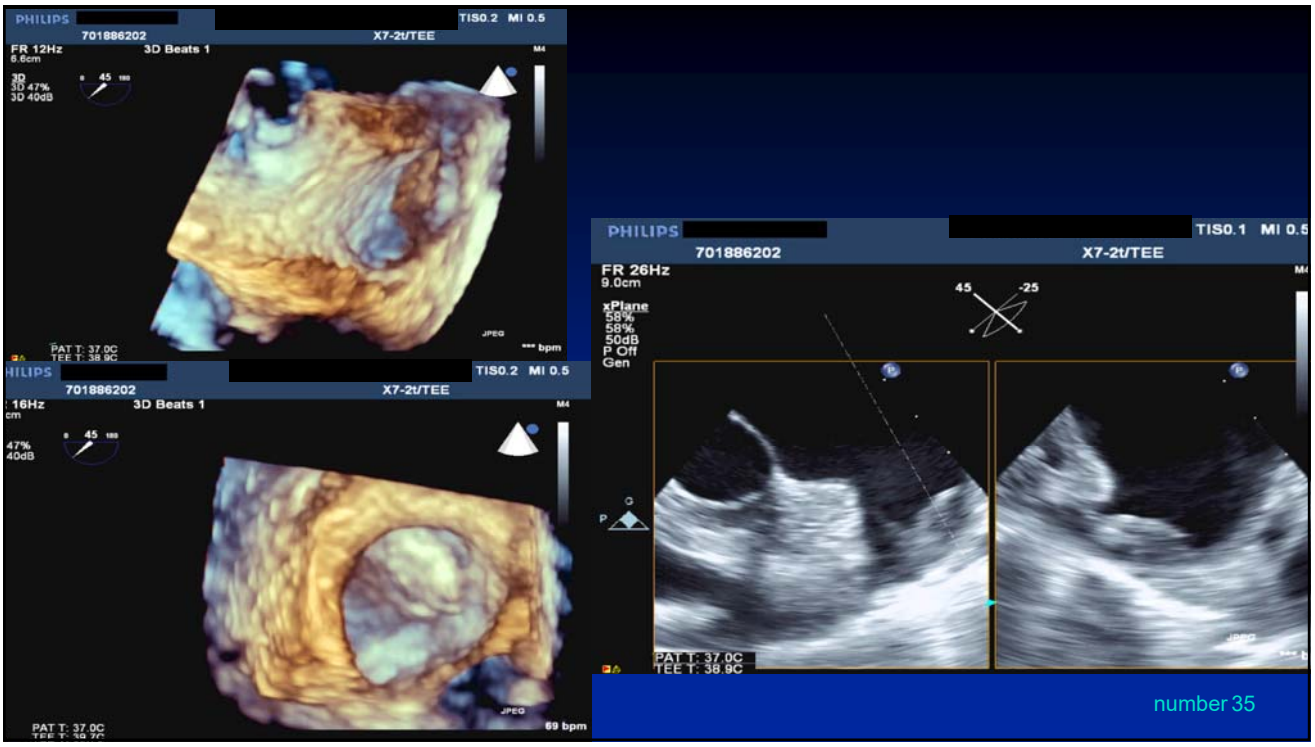


number 33

6 month f/u pre Watchman



number 34



Prognostic Significance of Left Atrial Appendage "Sludge" in Patients with Atrial Fibrillation: A New Transesophageal Echocardiographic Thromboembolic Risk Factor

- 340 AF pts pre CVD or PV isolation
- Evaluation with TTE and TEE
  - SEC 84pts (25%)
  - "sludge" 47 pts (14%)
  - Thrombus 62pts (18%)
  - Controls 147pts (43%)
- Outcome measures (F/U 6.7±3.7yrs)
  - Thromboembolic events (CVA, TIA, other emboli)
  - All-cause mortality

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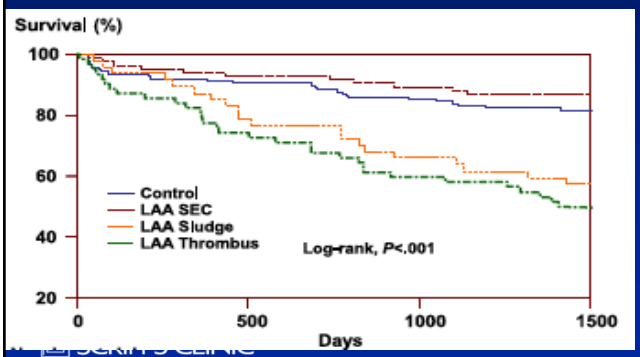
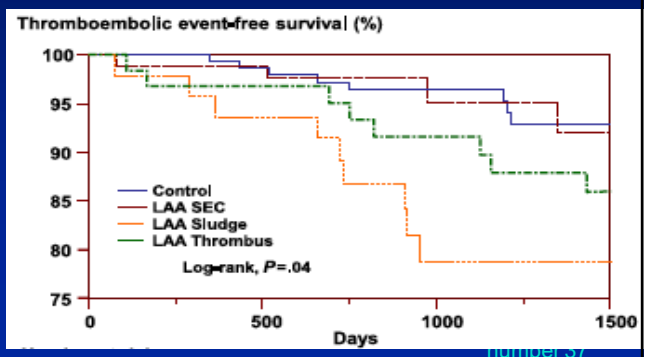
JASE 2014;27:1176

number 36

Rates of Thromboembolism and All-Cause Mortality

Outcome	Control	SEC	Sludge	thrombus
Death	40/147(27%)	15/84(18%)	27/47(57%)	39/65(63%)
Thromboembolic Event	10/137(7%)	9/78(12%)	11/44(25%)	11/55(20%)

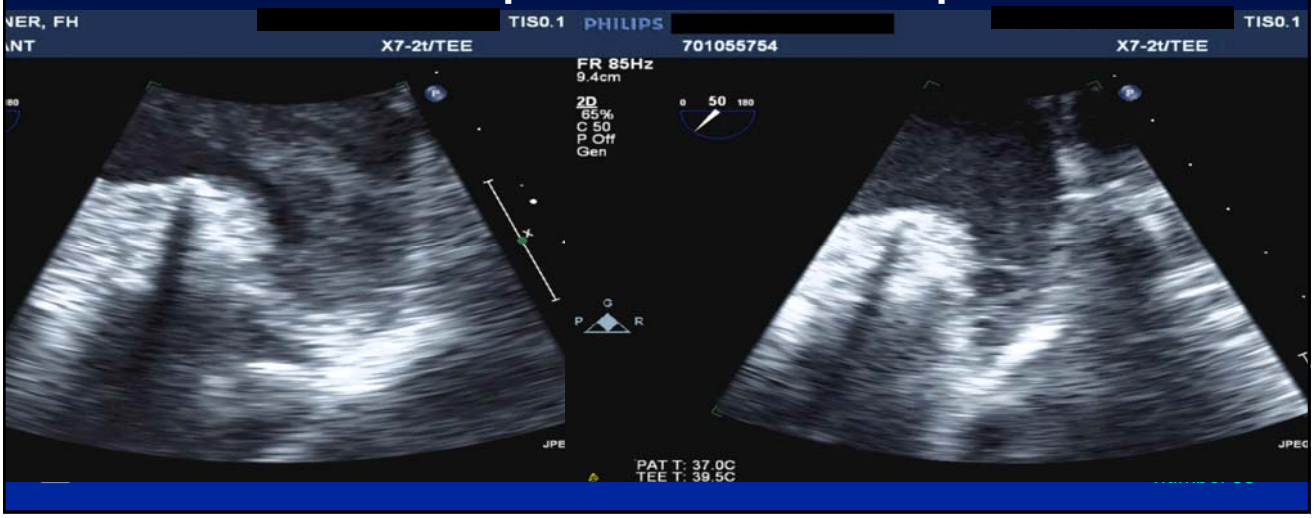




JASE 2014:27:1176

Elderly male chronic AF with AS post TAVR

At time of TAVR implant **1 month post TAVR**



86 y/o female pre Watchman implant Chr AF, Hx GI bleedng, frail with falling episodes

number 39

Other imaging modalities may be helpful....

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number 40

TABLE 4 Comparison of the Different Imaging Modalities for Assessment of the LAA

	TEE	MDCT	CMR
Sensitivity/specificity for LAA thrombi detection	92%–100%/ 98%–99%	96%/92%	67%/44%
Spatial resolution	0.2–0.5 mm	0.4 mm	1–2 mm
Temporal resolution	20–33 ms	70–105 ms	30–50 ms
3D volume rendering	Yes (with 3D)	Yes	Yes
Contrast required	No*	Yes	No*
Ionizing radiation	No	Yes	No
Special considerations	Widely available, provides real-time assessment Semi-invasive	Noninvasive, dynamic assessment of LA function Cannot be performed real-time during procedures Limited availability	Noninvasive, cannot be performed real-time during procedures Limited availability Cannot be performed in patients with pacemakers

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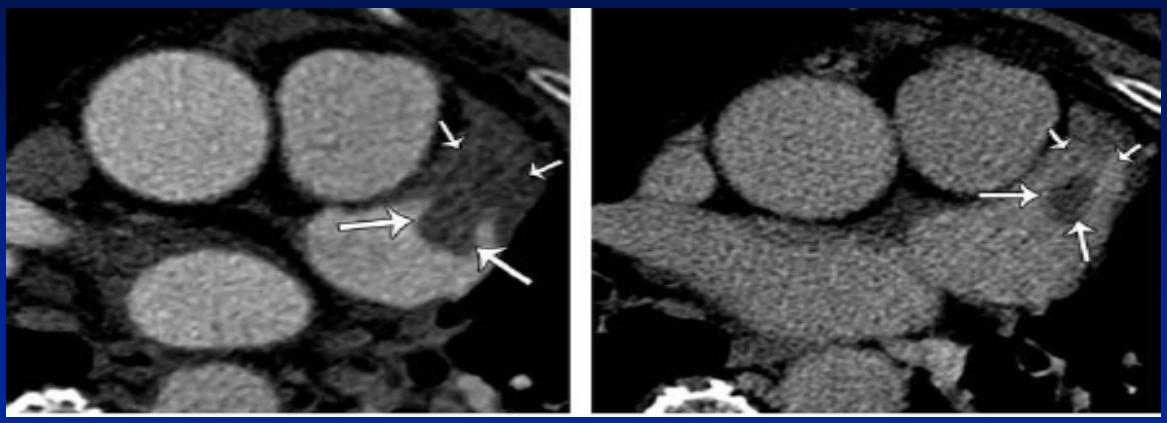
JACC IMAG 2014;7:1251

number 41

CT



SCRIPPS CLINIC

Radiology 2009;251:683

number 42

TABLE 1 LA and LAA Imaging-Based Variables to Predict Stroke

Conventional echocardiography	LA dilation (M-mode)
	Spontaneous echo contrast
	LAA thrombus
	LAA peak velocity <20 cm/s (pulsed-wave Doppler)
	LAA non-chicken wing shape
Speckle tracking echocardiography	LA longitudinal strain (reservoir function)
Cardiac magnetic resonance	LA volume
	LA longitudinal strain (reservoir function, tissue tracking CMR)
	LA fibrosis (LGE-CMR)
	LA flow (4D-CMR)
	LAA non-chicken wing shape
Multidetector row computed tomography	LAA non-chicken wing shape

4D = 4-dimensional; CMR = cardiac magnetic resonance; LA = left atrium; LAA = left atrial appendage; LGE = late gadolinium enhancement.

JACC 2017 70:3157

number 43

Forbes / Technology will replace 80-percent of what doctors do

BY VINOD KHOSLA

This post was also published by Fortune.

Data-driven healthcare won't replace physicians entirely, but it will help those receptive to technology perform their jobs better.

2012

A Computer-Aided Diagnostic Algorithm Improves the Accuracy of Transesophageal Echocardiography for Left Atrial Thrombi

A Single-Center Prospective Study

J Ultrasound Med 2014;33:83

REVIEW TOPIC OF THE WEEK

Structure and Function of the Left Atrium and Left Atrial Appendage

AF and Stroke Implications

JACC 2017

- Current risk stratification in AF is based on clinical scores
  - Do not include LA remodeling and function
- Multimodality imaging provides a comprehensive evaluation that includes parameters of risk before thrombus formation
- OAC effective, but not perfect, in reducing stroke risk in those with high clinical risk scores
- In patients at lower risk, use of other parameters should be considered (eg strain)

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number 45