Baptist Health
HEART INSTITUTE

Interpretation of Non-Invasive Testing

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February 28, 2025

Disclosures: None

Objectives

- Discuss common non-invasive cardiac tests used in clinical practice.
- Review findings from non-invasive cardiac tests to guide patient care

Where are we headed

- Echocardiography: both transthoracic (TTE) and transesophageal (TEE)
- Nuclear Cardiology (SPECT-MPI)
- Coronary CT Angiography (CCTA)
- A word on Event Monitoring/Holters

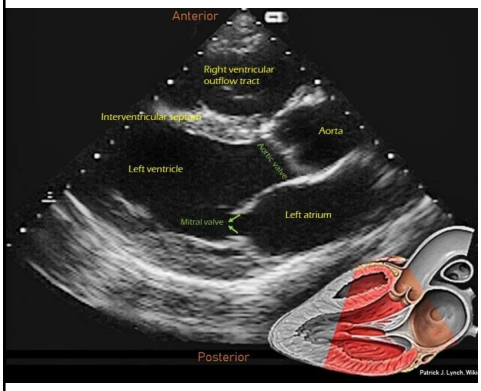
General Approach to the Test Result

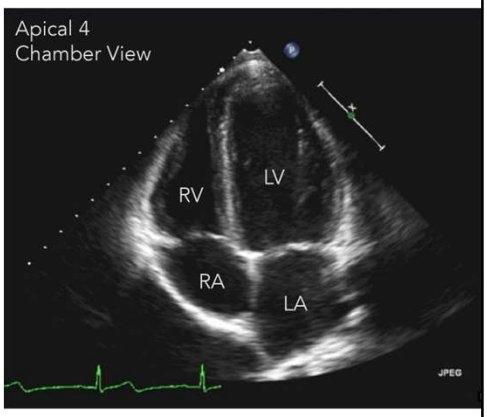
- A well written report should answer the clinical question (or indication for testing) and clue you into any unexpected significant findings
- Start with the "Conclusion," then dig into the detailed findings
- If it's unclear, call the reading physician

Echocardiography

- Pros:
  - Quick to perform
  - Low cost
  - Safe
  - Great resolution (both spatial and temporal)
  - No radiation dose (to patient or staff)
- Cons:
  - Not everyone has good windows; and you can’t comment on what you can’t see

Echocardiography





Procedure Summary
Summary:
Normal LV chamber dimensions and wall thickness.
Normal LV systolic function, estimated LVEF 55-60%; normal diastolic function
No regional wall motion abnormality seen.
Normal RV size and systolic function.
Normal tricuspid valve structure; no stenosis; trivial regurgitation
PA systolic pressure is estimated at 20 mmHg

No prior studies available for comparison

Electronically signed by Von Edwins, MD Kirby (Interpreting physician) on 12/27/2024 at 4:37 PM
Findings
Left ventricle:
Normal LV chamber dimensions and wall thickness.
Normal LV systolic function, estimated LVEF 55-60%; normal diastolic function
No regional wall motion abnormality seen.
Right ventricle:
Normal RV size and systolic function.
Left atrium:
Normal LA size
Right atrium:
Grossly normal RA size
Aortic valve:
Structurally normal trileaflet aortic valve.
No significant Aortic valvular stenosis; no regurgitation
Mitral valve:
Normal mitral valve structure; no stenosis; no regurgitation
Pulmonary valve:
Pulmonic valve not well visualized; no stenosis; no regurgitation
Tricuspid valve:
Normal tricuspid valve structure; no stenosis; trivial regurgitation
PA systolic pressure is estimated at 20 mmHg
Pericardium & pleura:
No evidence of pericardial effusion.
Aorta:
The aorta is within normal limits.
Shunts findings:
No evidence of shunts visualized via color doppler
Miscellaneous:
IVC normal size, compressible

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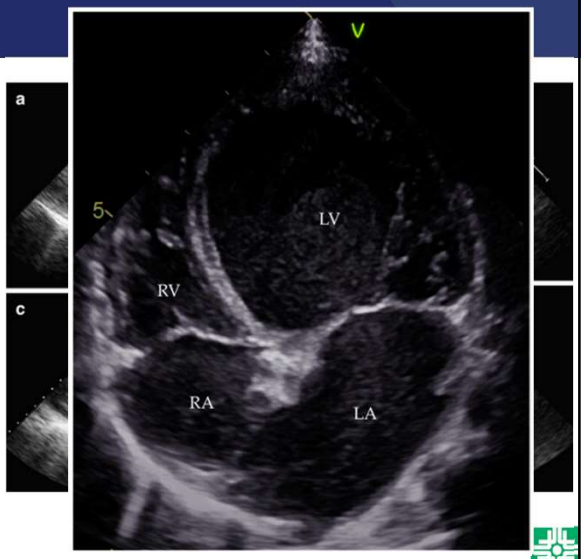
Echocardiography: Left Ventricular Structure

- Wall Thickness
  - Hypertrophy (mild, moderate, severe)
- LV cavity dimension
  - Normal
  - Dilated

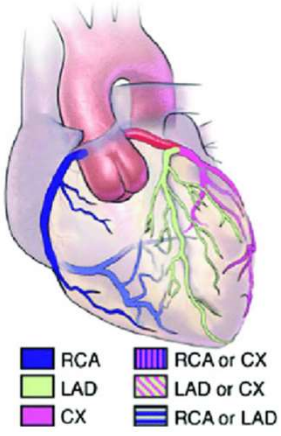


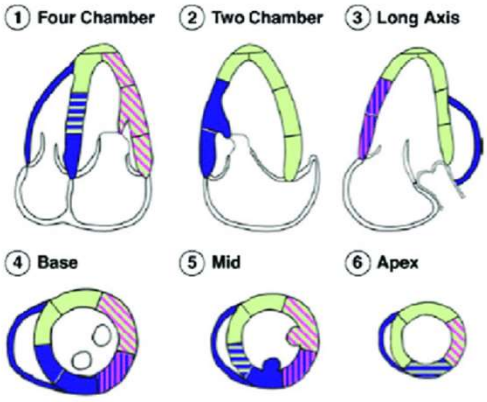
Echocardiography: Left Ventricular Systolic Function

LV Ejection Fraction

- Hyperdynamic >70%
- Normal 50-69%
- Mildly reduced 40-49%
- Moderately reduced 30-39%
- Severely reduced <30%

Echocardiography: Left Ventricular Wall Motion Abnormalities





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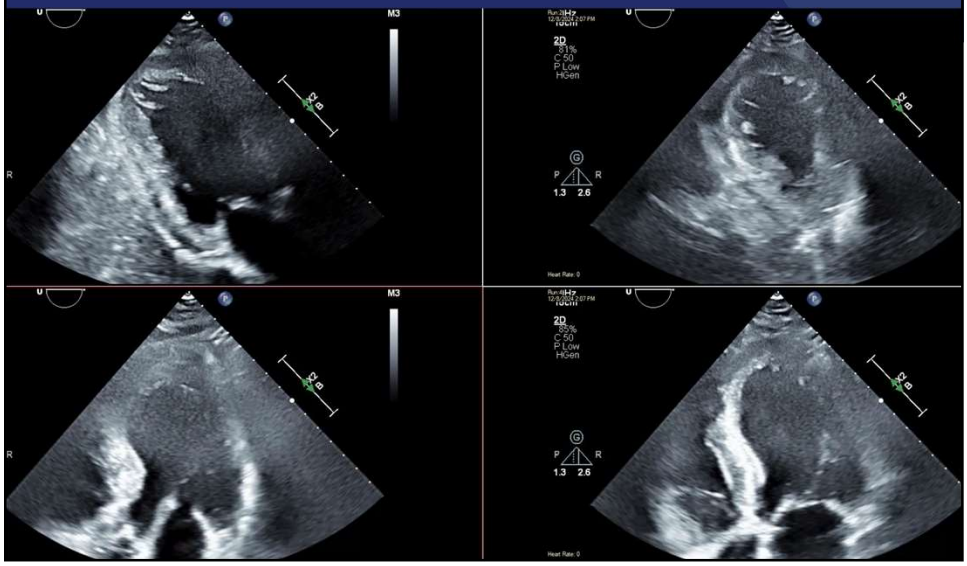

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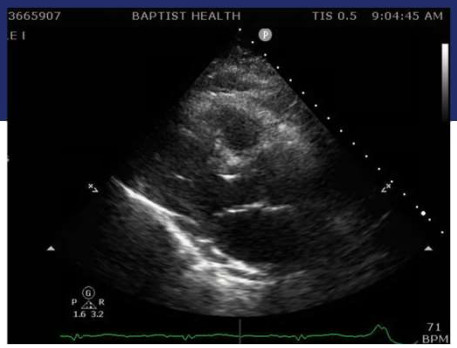
Echocardiography: Aortic Valve



- Valve anatomy: tricuspid, bicuspid, unicuspid
- Regurgitation
  - Severity: trivial, mild, moderate, severe
  - Associated findings: dilated/aneurysmal aortic root, premature mitral valve closure, etc
- Stenosis
  - Severity: mild, moderate, severe

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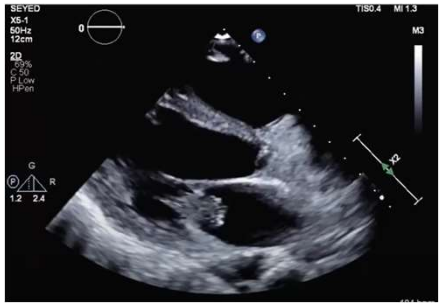
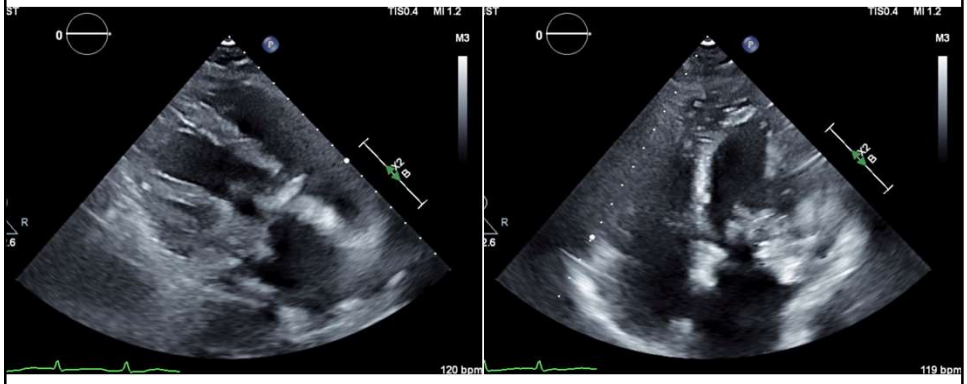
Echocardiography: Mitral Valve

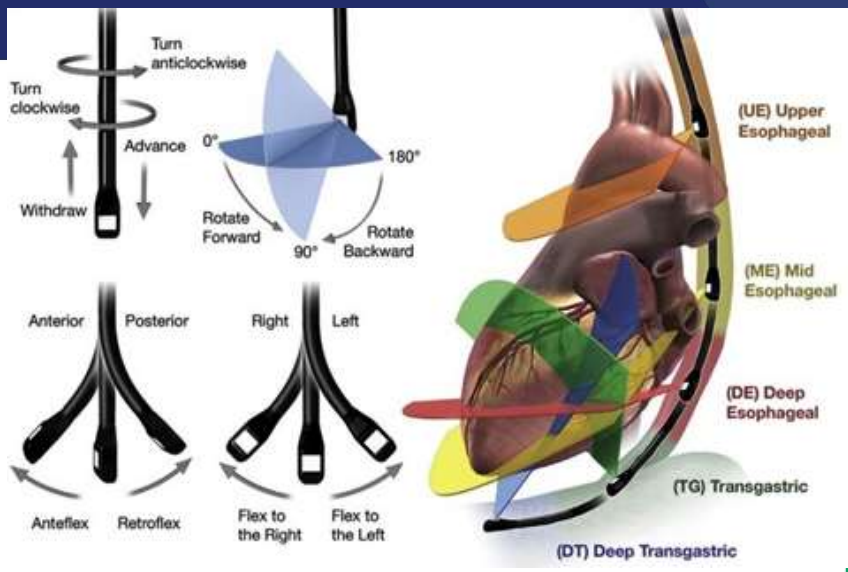
- Regurgitation
  - Severity: trivial, mild, moderate, severe
  - Etiology: primary (prolapse, flail leaflet) or secondary (ischemic, heart failure)
- Stenosis
  - Severity: mild, moderate, severe
  - Etiology: rheumatic, calcific



Echocardiography: Masses/Thrombi



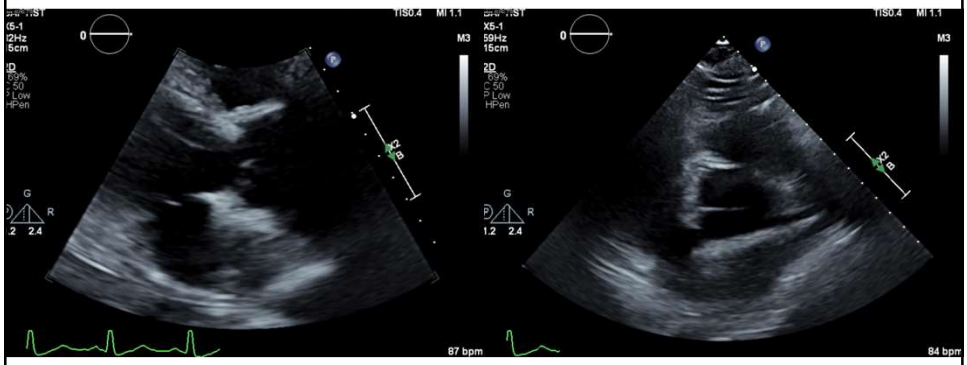
Transesophageal Echocardiography



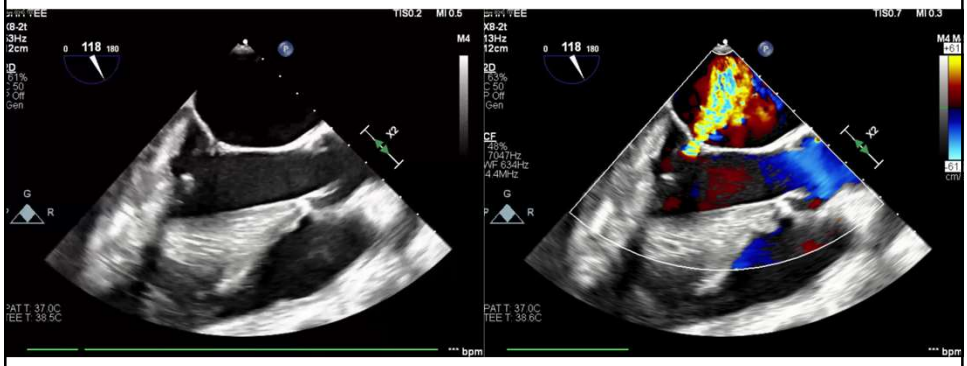
Advantages of Transesophageal Echocardiography

- Probe is physically closer to the cardiac structures, leading to drastically improved resolution
- No “narrow rib spaces” or “poor lung windows” to affect image quality
- Better assessment of the aorta compared to Transthoracic studies

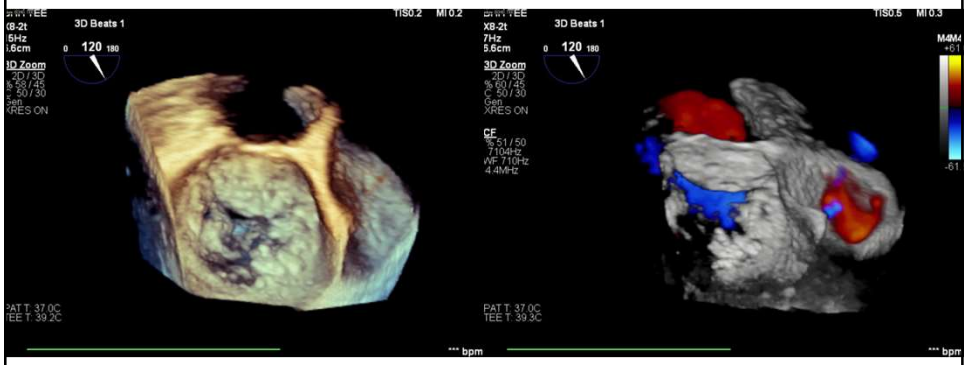
Advantages of Transesophageal Echocardiography



Advantages of Transesophageal Echocardiography

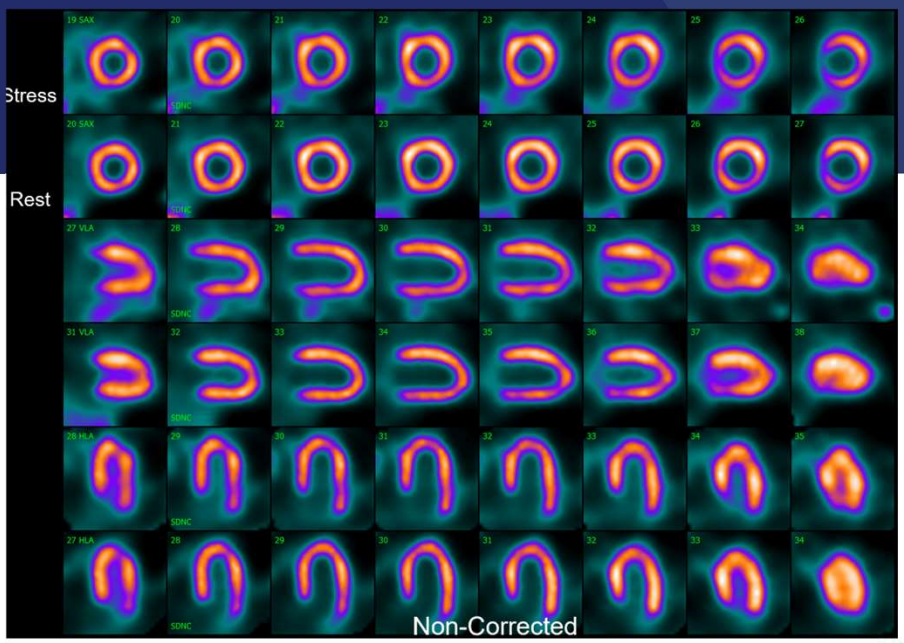


Advantages of Transesophageal Echocardiography



Nuclear Cardiac Imaging

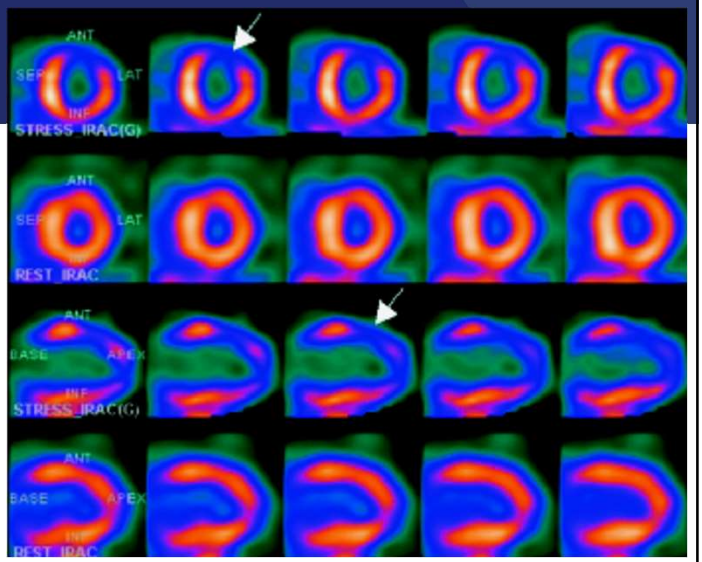
- Single-Photon Emission Computed Tomography (SPECT) Myocardial Perfusion Imaging
- The Big Idea: perfuse the heart with radioactive isotope (Technetium-99m sestamibi) at rest and stress, then compare
- Stress modalities:
  - Exercise vs Pharmacologic (mostly commonly Regadenoson).
- Gated SPECT allows for LVEF calculation
- Perfusion defects to assess for ischemia or prior myocardial infarction (both transmural and nontransmural)



Ischemia on SPECT

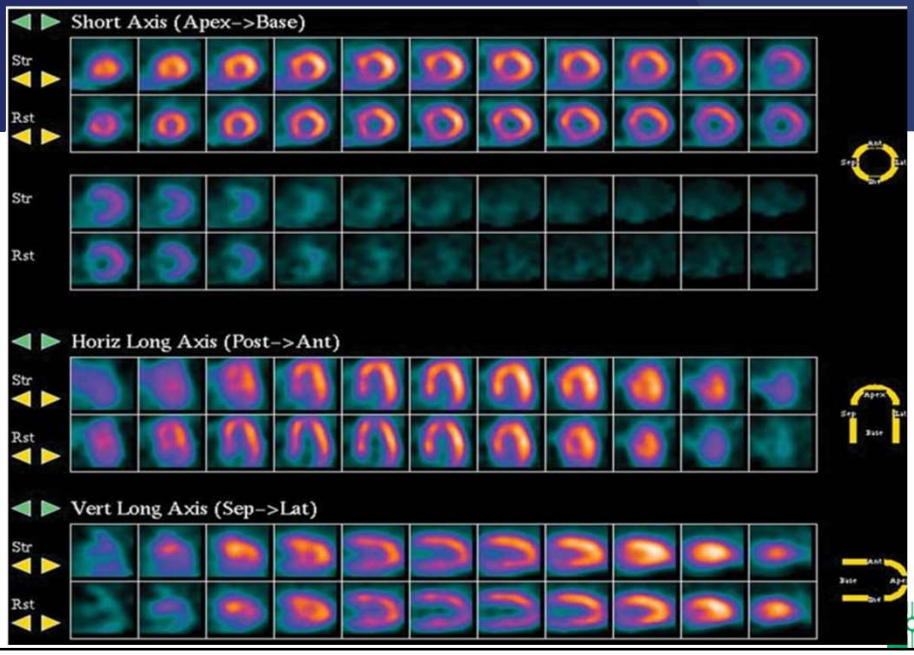
Positive studies should tell you:

- Location
- Size
- Intensity
- Reversibility



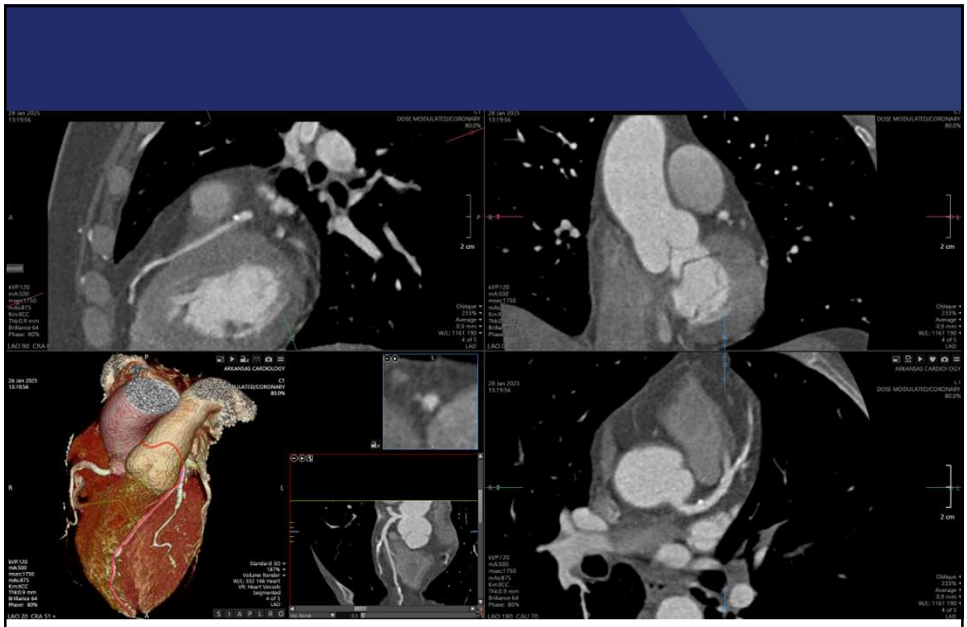
Large sized, severe intensity, reversible perfusion defect in the mid to apical anterior and anterolateral walls along with apex, consistent with myocardial ischemia.

Prone to artifacts



Coronary CT Angiography (CCTA)

- Now part of the Chest pain guidelines
- Calcium scoring in combination
- The benefit of non-obstructive CAD detection, along with high-risk features in obstructive disease (Left Main, triple vessel)
- CAD-RADS system
- HeartFlow for FFR-CT flow assessment
- When retrospective acquisition is used, we can obtain an LVEF



CLINICAL INDICATION:
The patient is a [redacted] with chest pain who is to undergo CT angiography for evaluation.

TECHNIQUE:
Gated CT cardiac scan was done on a Philips 64 slice scanner. A non-contrast scan was performed for calcium scoring, followed by contrast infusion scan for coronary angiography. Advanced 2D and 3D post-processing was done on the workstation to evaluate the heart and coronary arteries. Post-processed images with maximal intensity projection (MIP), multi-planar reconstruction (MPR), and volume rendered technique (VRT) were used in optimal cardiac phase for imaging. This study focuses solely on the cardiac structures.

MEDICATIONS ADMINISTERED: Omni 350 75ml @ 4.5 ml/sec Tng 800 mcg

RADIATION DOSE: 1395.1 mGy*cm. Tube modulation was used.

QUALITY OF STUDY:

MEASUREMENTS (short axis):
Aortic annulus diameter = 3.3cm (2.0- 3.7)
Ascending aorta diameter = 2.8cm (2.0- 3.7)
Descending aorta diameter = 2.1cm (2.0- 3.7)
RV diastolic diameter = 0.9cm (0.7- 2.3)
LV septal wall thickness = 0.9cm (0.6- 1.1)
LV posterior wall thickness = 0.8cm (0.6- 1.1)
LV diastolic diameter = 3.4cm (3.6- 5.2)
LV systolic diameter = 1.2cm (2.3- 4.9)

CORONARY ARTERY CALCIUM (CAC):
1. Left main artery: 0
2. Left anterior descending artery: 218
3. Posterior circumflex artery: 125
4. Right coronary artery: 80

CAC Score = 423

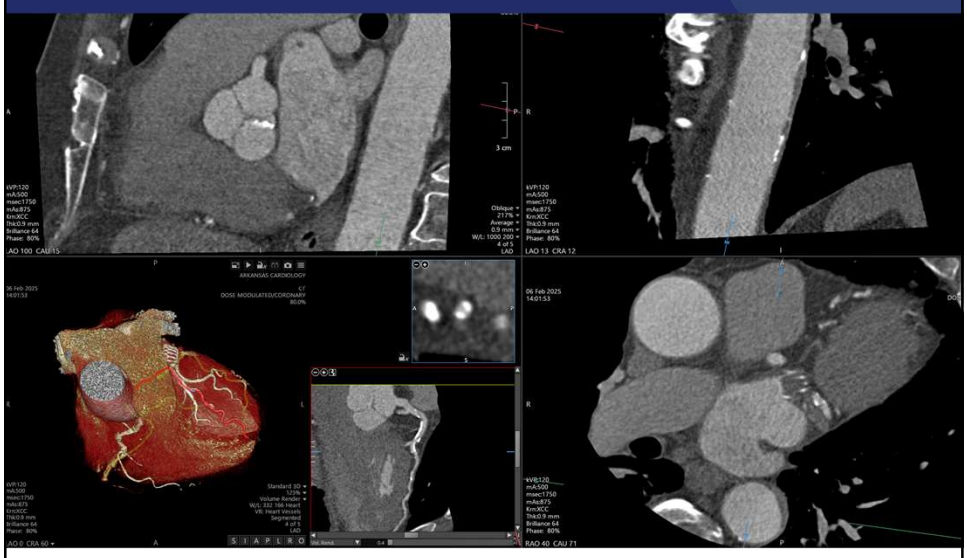
CAC SCORE:
1-112 = Average Risk
100-400 = Moderate Risk
400-999 = High Risk
> 1000 = Very High Risk
(ACCF/AHA Consensus JACC 2007;49:378-402)

ANGIOGRAPHY: Technically adequate study. Multiple phases were used primarily for analysis.
1. Left main artery is normal in caliber and without significant stenosis.
2. Left anterior descending artery is normal in caliber. The proximal LAD has 1-24% stenosis. The distal LAD has 50-69% stenosis. The large first diagonal branch has 50-69% stenosis.
3. The circumflex artery is normal in caliber. The proximal left circumflex has 1-24% stenosis. The proximal OM1 has 50-69% stenosis.
4. Right coronary artery is normal in caliber. The proximal RCA has 1-24% stenosis. This is a dominant vessel, giving rise to the posterior descending artery.
5. Normal LV function with an EF of 88 %
6. Normal pulmonary vein anatomy; no filling defect in the left atrial appendage

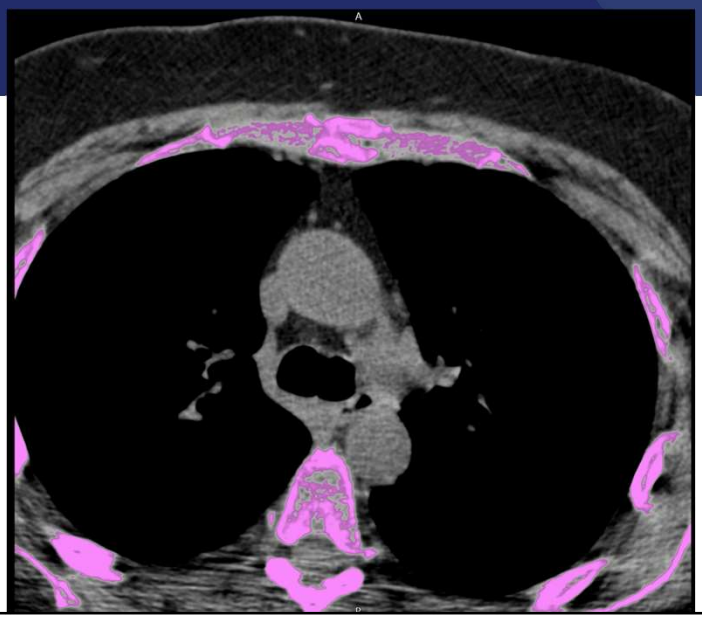
Stenosis severity: CADRADS 3

IMPRESSION:
1. Coronary artery calcium score 423
2. The proximal LAD has 1-24% stenosis. The distal LAD has 50-69% stenosis. The large first diagonal branch has 50-69% stenosis
3. The proximal left circumflex has 1-24% stenosis. The proximal OM1 has 50-69% stenosis
4.The proximal RCA has 1-24% stenosis
5. Normal left ventricular size and function, EF 88%

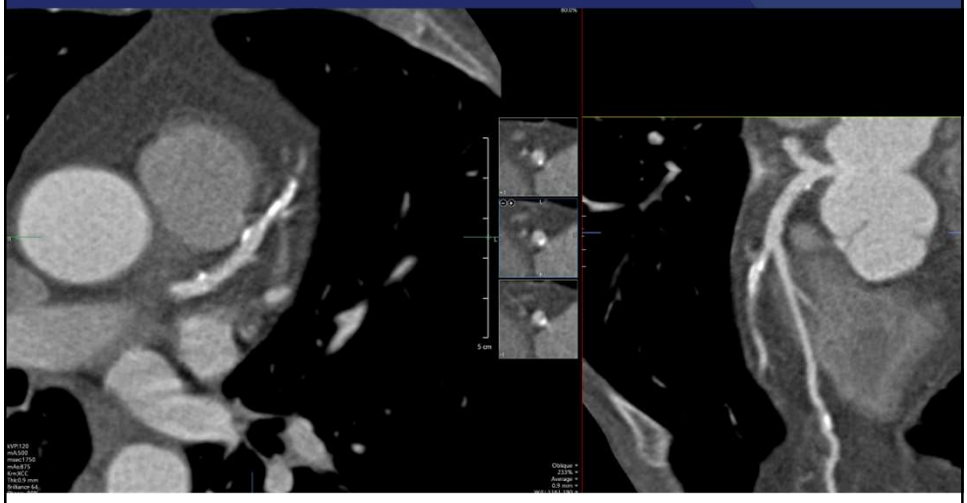
CT FFR evaluation recommended



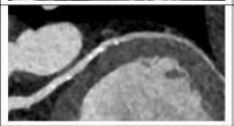
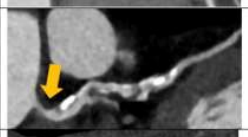
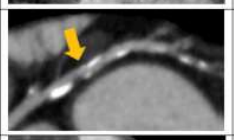
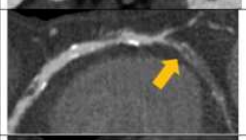
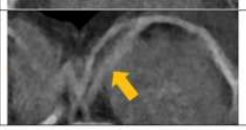
Calcium Scoring

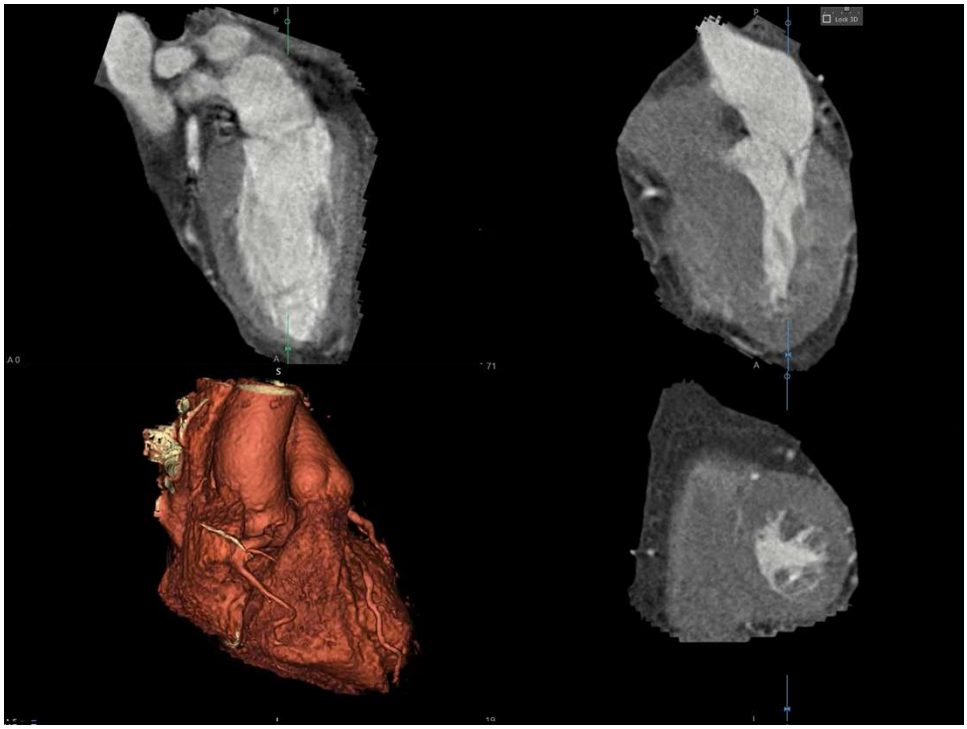


Angiography

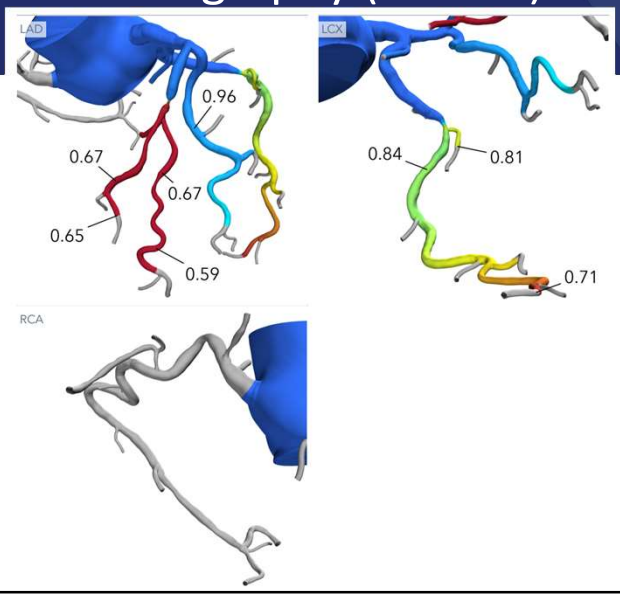


Coronary Artery Disease-Reporting and Data System (or CAD-RADS)

Category	Representative Case	Category	Representative Case
CAD-RADS 0 -no plaque or stenosis *		**CAD-RADS 4A** -max stenosis 70-99% * (severe)	
CAD-RADS 1 -max stenosis 1-24% * (minimal) -includes plaque with positive remodeling and no stenosis		**CAD-RADS 4B** -left main stenosis >50% *or* -3-vessel obstructive (≥70%) disease *	
CAD-RADS 2 -max stenosis 25-49% * (mild)		**CAD-RADS 5** -100% stenosis (total occlusion)	
CAD-RADS 3 -max stenosis 50-69%** (moderate)		**CAD-RADS N** -non-diagnostic study (not all segments >1.5 mm diameter can be interpreted with confidence)	



Fractional Flow Reserve Computed Tomography (FFR-CT)



Fractional Flow Reserve Computed Tomography (FFR-CT)

$$FFR = \frac{\text{Distal Coronary Pressure (Pd)}}{\text{Proximal Coronary Pressure (Pa)}}$$

(During Maximum Hyperemia)

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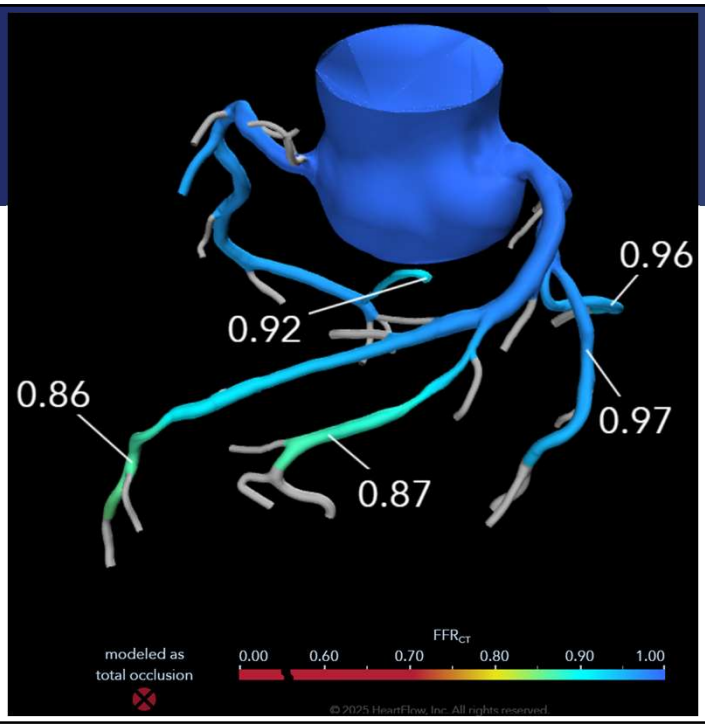

FFR-CT

CT-FFR Addendum to Coronary CTA dated 1/28/2025

Methods
CCTA data images prepared and securely transmitted to HeartFlow. HeartFlow Analysis was performed on the CCTA dataset. This dictation was created using the PDF analysis and an interactive 3D model of FFRct.

Findings
The entire Left Main has no significant stenosis with FFRCT value of 1.0.
The distal LAD has a focal stenosis with FFRCT value of 0.86 and the proximal first diagonal has a focal stenosis with FFRCT 0.87.
The proximal OM has a focal stenosis with FFRCT value of 0.97.
The entire RCA has no significant stenosis with FFRCT value of 0.92.

Impression
Anatomic stenosis in distal LAD, diagonal, and OM with lesion-specific FFRct > 0.80; consider medical therapy as front-line strategy

Downsides to CCTA

- Think about radiation dose in females (i.e. breast cancer risk)
- Severe range obesity (or primarily visceral fat) can affect your resolution
- May want to consider an alternate test if you are not confident HR can be controlled (i.e. already on large doses of AV nodal blockers)

Cardiac Event Monitors/Holters, briefly

- Types of monitors: live vs non-live
- Length of duration of monitoring
- What is the question and the frequency of symptoms? (don't do a month if it's happening daily, don't do 1 week of it's post CVA arrhythmia monitoring)
- Our holters give PVC morphology, which is helpful to our EP colleagues
- "Symptoms DID or DID NOT correlate with the above observed arrhythmia/ectopy"

Let's Recap

- Echocardiography: both transthoracic (TTE) and transesophageal (TEE)
- Nuclear Cardiology (SPECT)
- Coronary CT Angiography (CCTA)
- A word on Event Monitoring/Holters

Did we satisfy our objectives?

- Discuss common non-invasive cardiac tests used in clinical practice.
- Review findings from non-invasive cardiac tests to guide patient care

General Approach to the Test Result

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