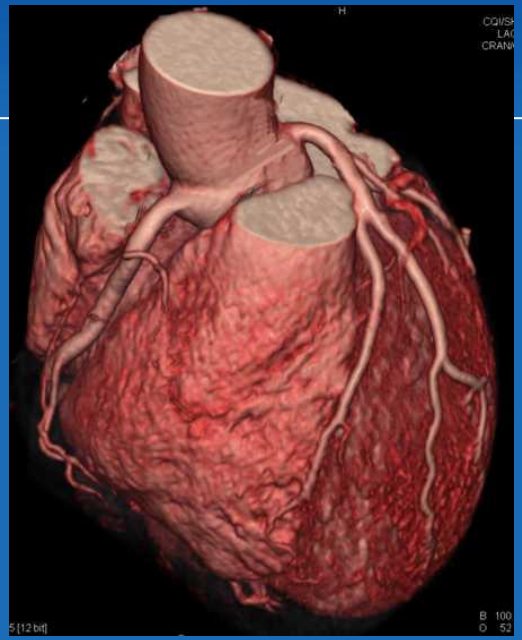
The role of CT in Cardiac Diagnostics

Dr Julie O Brien
Beacon Limerick



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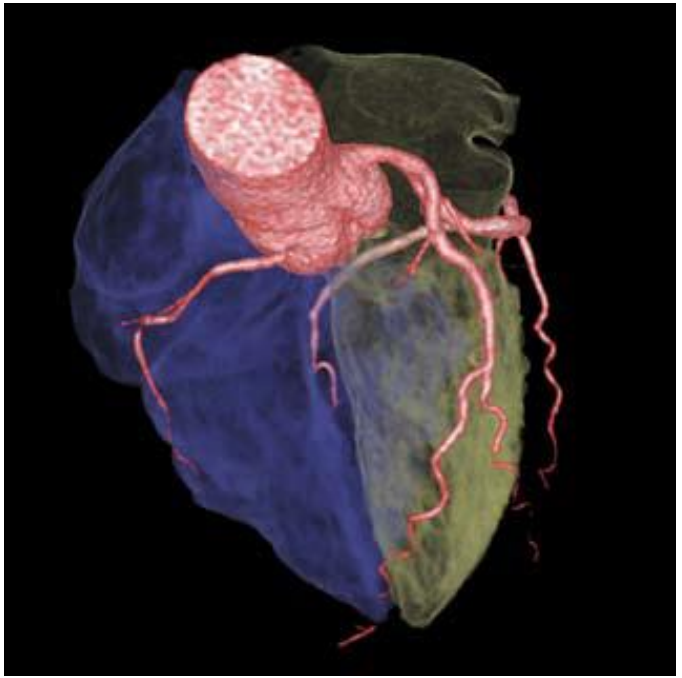
THIS IS MODERN MEDICINE

Objectives

- Background
- Patient Selection
- Acquisition and preparation
- Interpretation of Report



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Background

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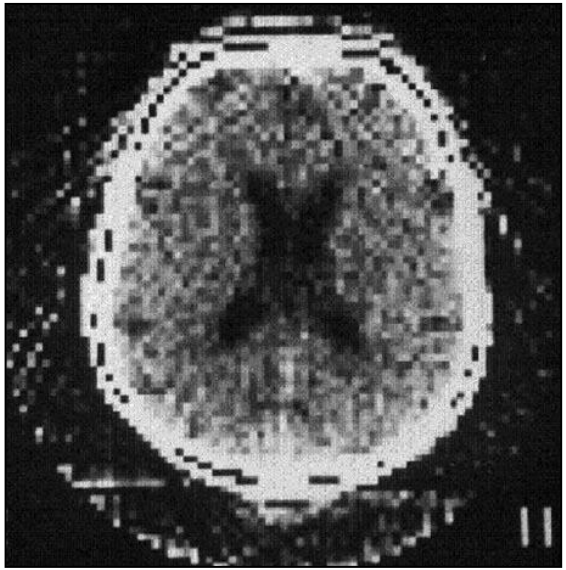
History of CT

October 1, 1971, Atkinson Morley Hospital in Wimbledon



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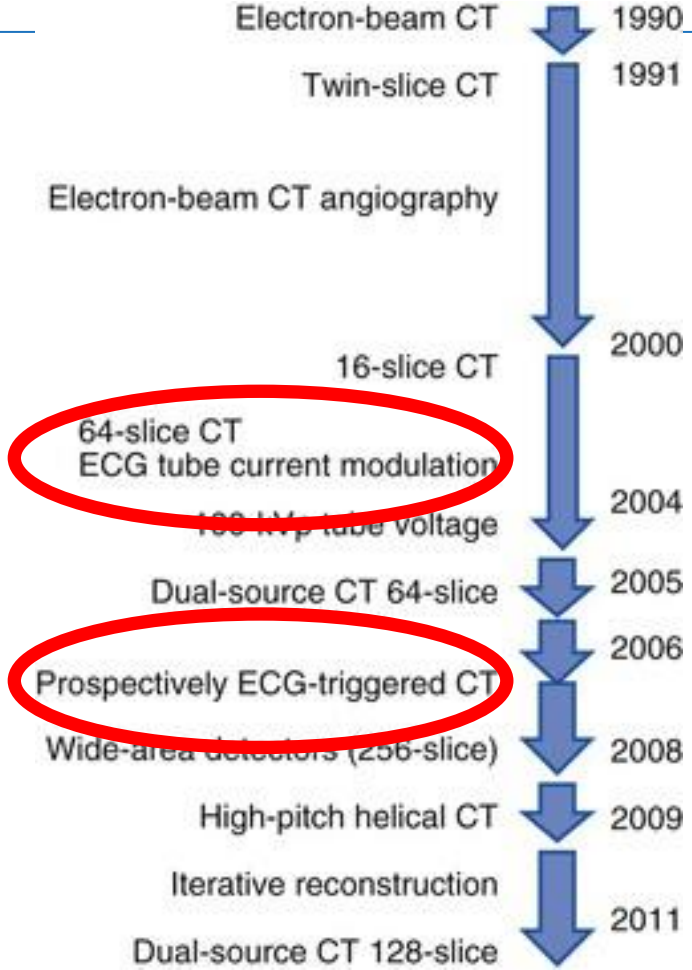
Timeline of Technical Advancement in CT



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How Accurate is Coronary CT Angiography?

Diagnostic Accuracy of CCTA

Table 2. Diagnostic Performance of 64-Slice CCTA According to Baseline Patient Risk

Pretest probability of CAD	n	Sensitivity	Specificity	PPV	NPV
High	105	98%	74%	93%	89%
Intermediate	83	100%	84%	80%	100%
Low	66	100%	93%	75%	100%

CAD indicates coronary artery disease; CCTA, coronary computed tomography angiography; NPV, negative predictive value; and PPV, positive predictive value. Adapted from Meijboom et al[3] with permission of the publisher. Copyright ©2008, Elsevier.

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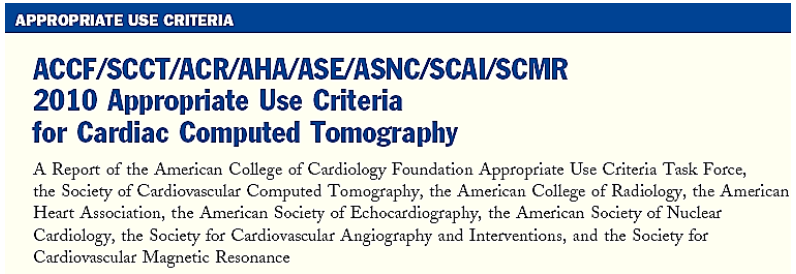
Accuracy of CCTA

- NPV 99 - 100%
- If reported as ‘negative’ it is ‘negative’ 99-100%
- Play to your strengths;

CCTA in patients with low or intermediate probability of CAD

Indications for CCTA


APPROPRIATE USE CRITERIA

ACCF/SCCT/ACR/AHA/ASE/ASNC/SCAI/SCMR
2010 Appropriate Use Criteria
for Cardiac Computed Tomography

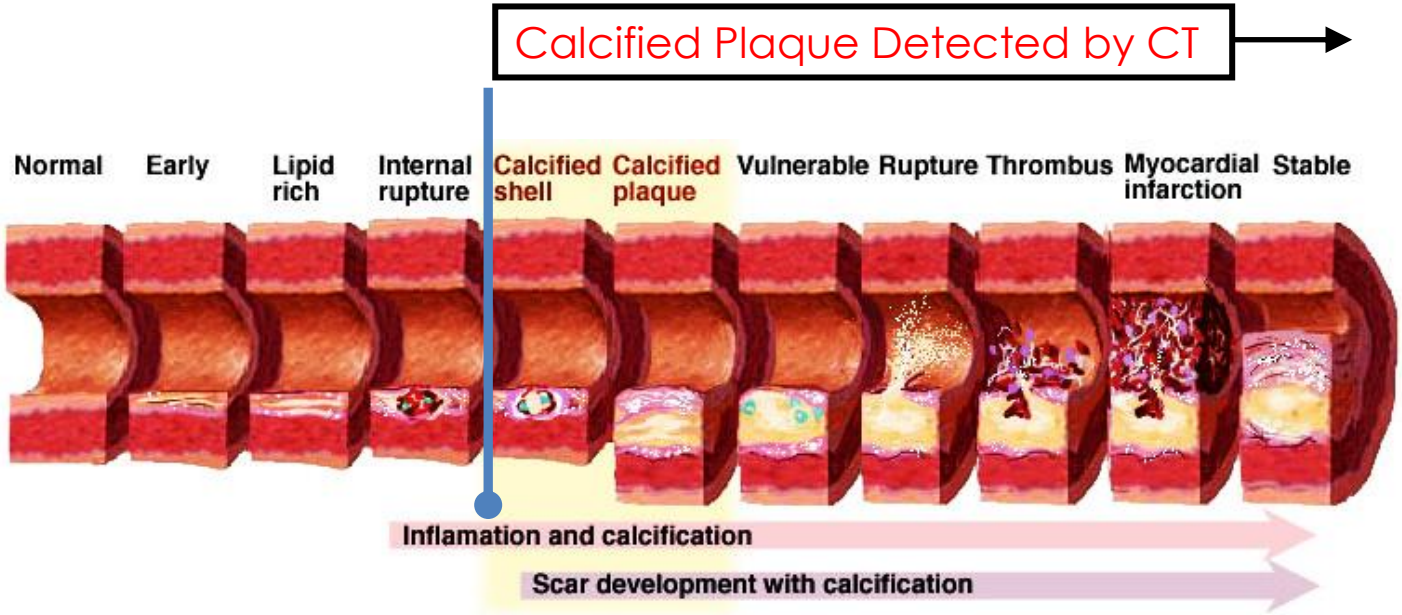
A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the Society of Cardiovascular Computed Tomography, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the American Society of Nuclear Cardiology, the Society for Cardiovascular Angiography and Interventions, and the Society for Cardiovascular Magnetic Resonance

- Appropriateness criteria
- Commonest : Stable chest pain
- Low to intermediate probability of CAD
- If high probability, better to undergo catheter angiogram
  - Higher incidence of calcium resulting in artifact and reduced accuracy
  - More likely to require intervention
- Limitations

What Are The Limitations of CCTA?

- Heart rate greater than 70 beats/min
- Irregular heart rhythm
- Inability to sustain breath hold for at least 5 - 10 sec
- Severe coronary calcification
- Segments with a diameter <1.5 mm

Coronary Disease Progression



Role for CCTA

>60% stenosis (+) stress/imaging

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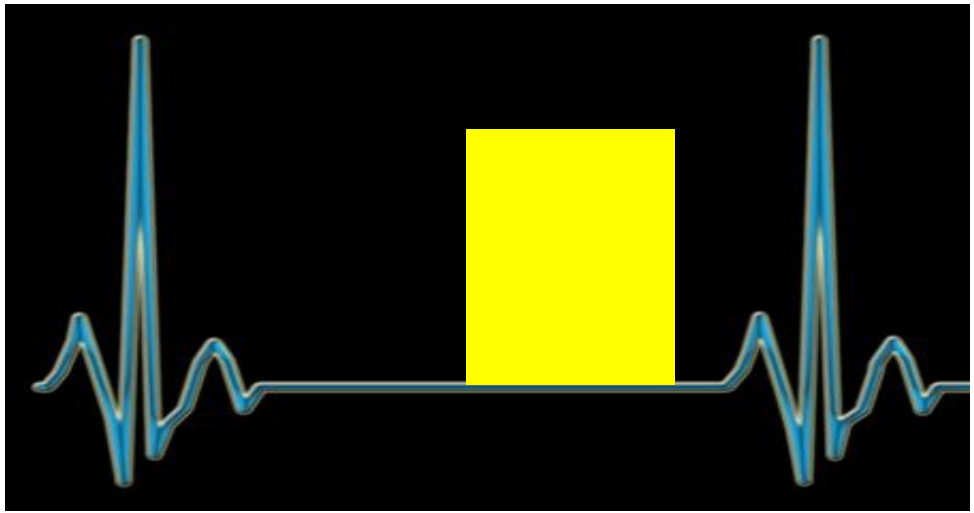
ECG Synchronisation

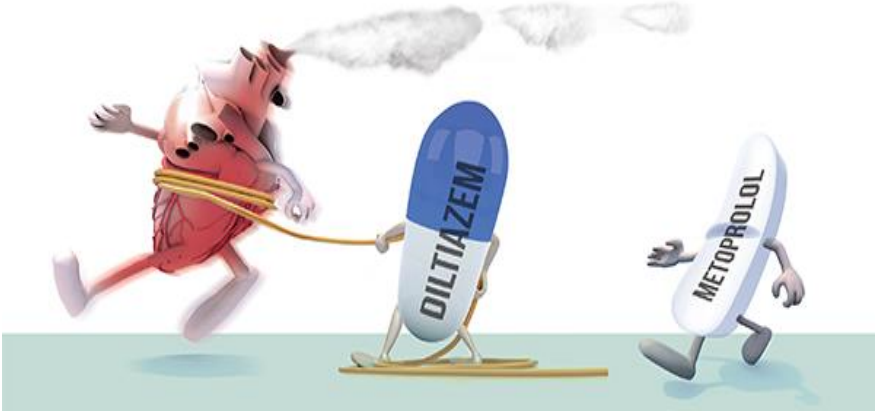
ECG monitoring used to trigger the CT imaging

Images are performed during the phase of the least cardiac motion



Rate Control

- Aim: stable slow heart rate
- Optimal <65bpm on standard 128 CT
- Beta blocker eg metoprolol
- Verapamil, ivabradine if C/I



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Nitrates

Effect on Vasculature

- Direct vasodilators
- Induce smooth muscle relaxation
- Cause dilation of the coronary arteries

Prior to Sublingual Nitrate administration

5 min after Sublingual Nitrate administration

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The Report

- Quality (Artifacts)
- Anomalous anatomy
- Plaque description
- Stenosis severity
- +-/- Calcium score
- Extra cardiac findings

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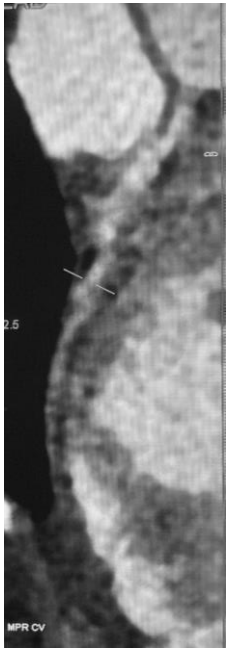
What About Artifacts ?

Coronary CT angiography is impressively accurate –

but there are challenges from artifacts

Calcium

Motion



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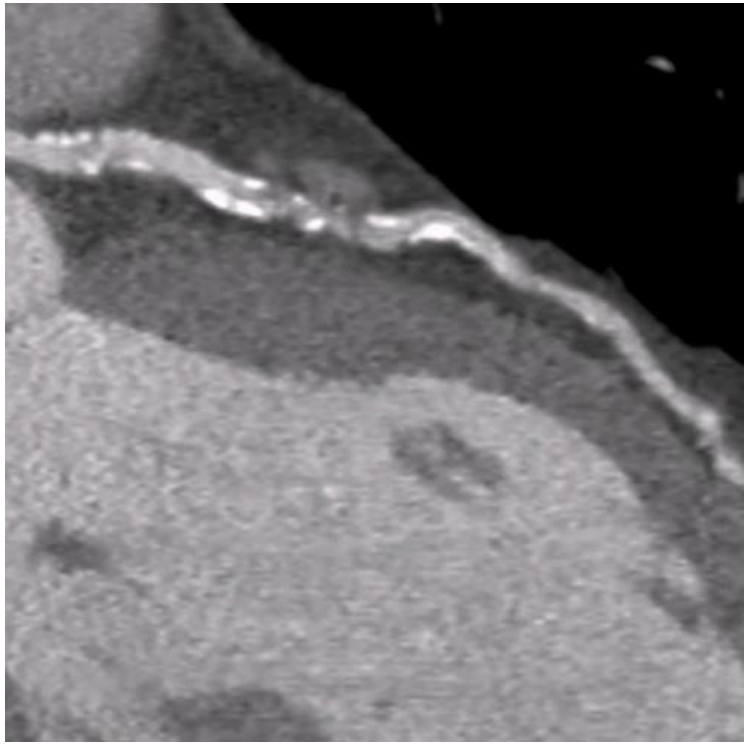
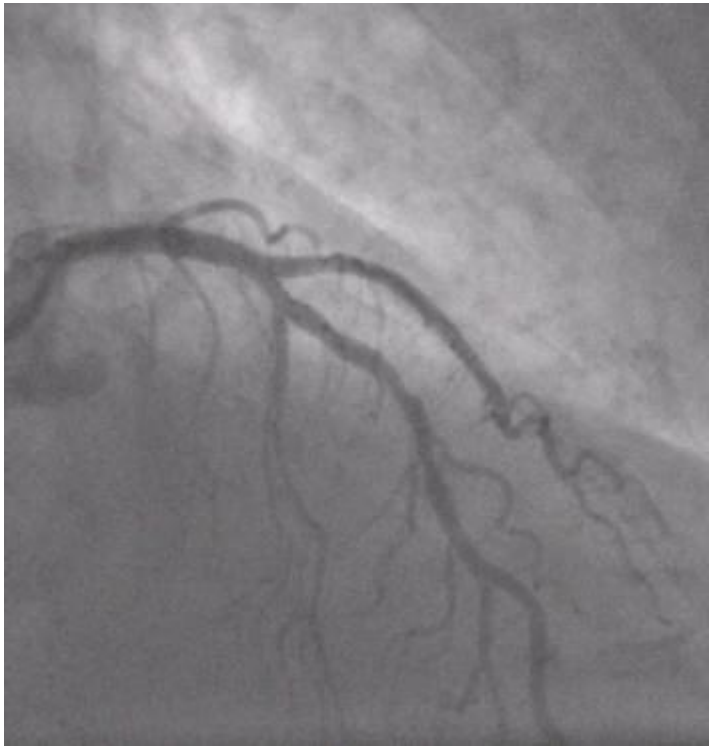
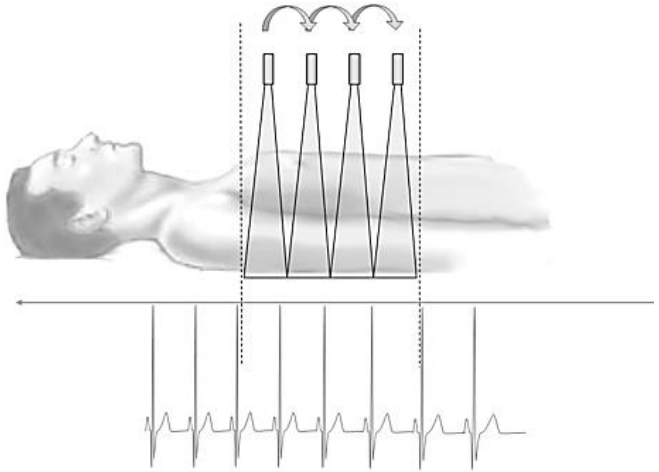
Calcium

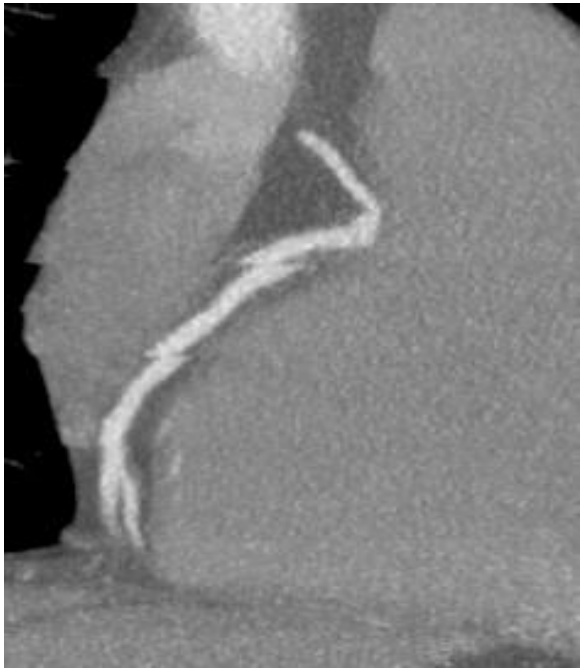
This causes overestimation of stenosis





Misregistration

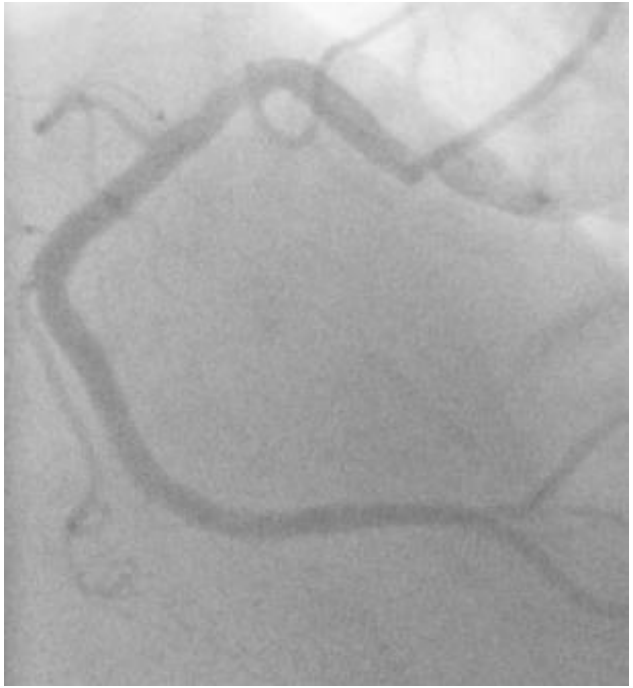




Breathing

Inconsistent heart beats

Misregistration



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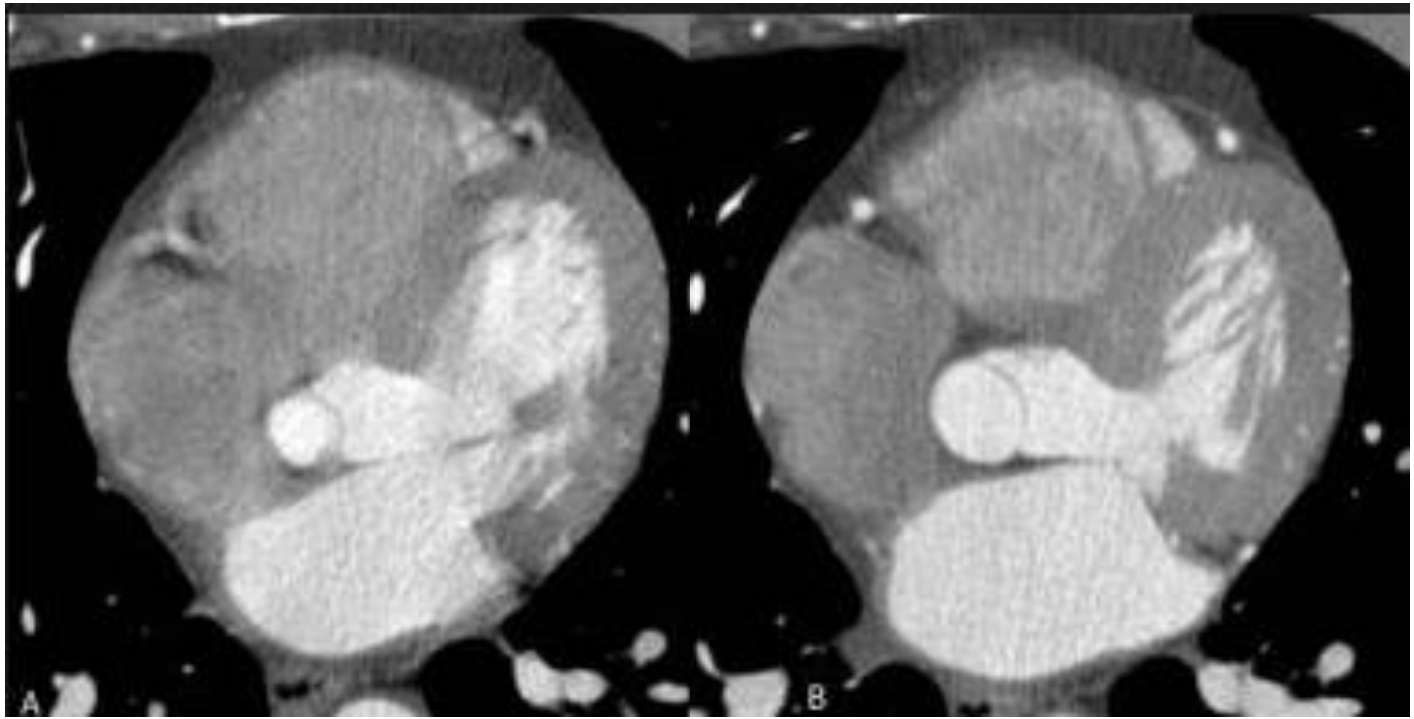
Motion



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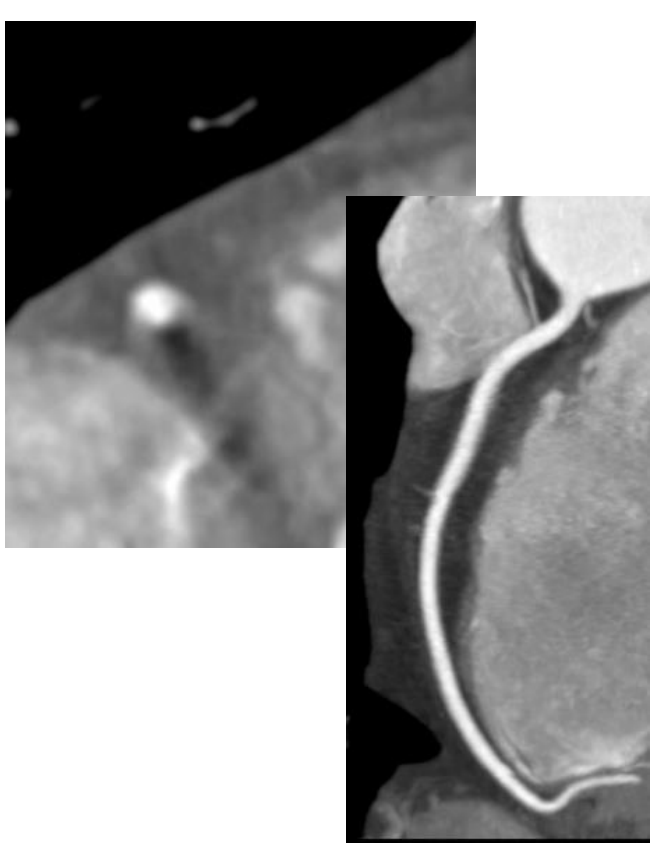
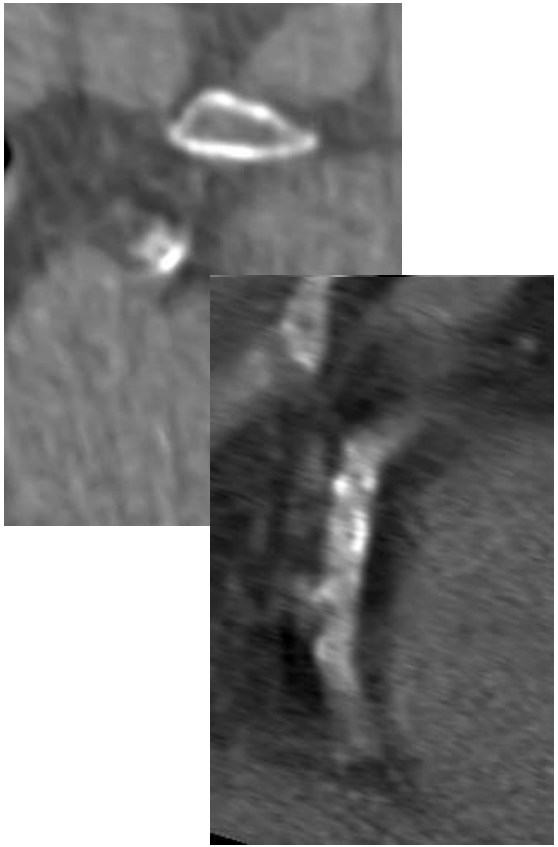
Motion +/- Calcium





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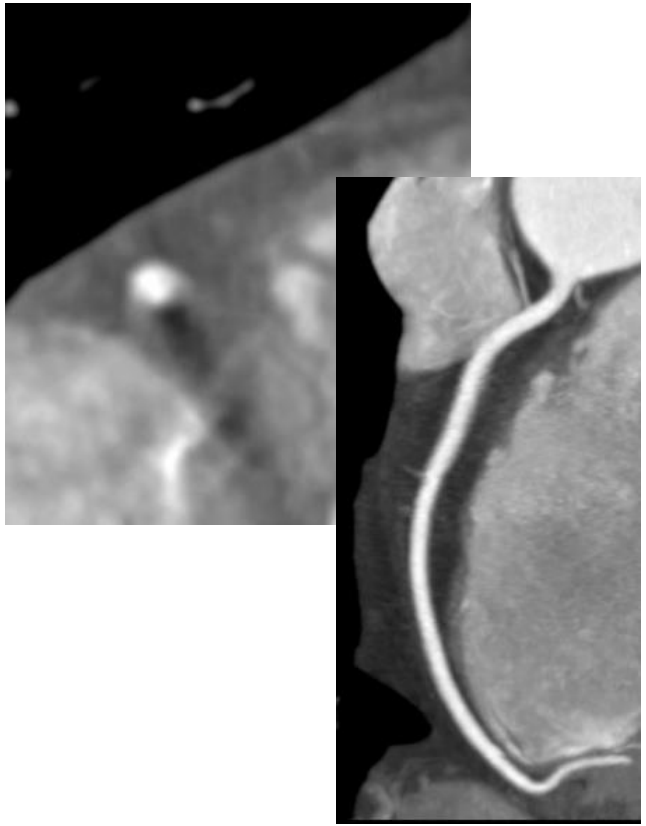
Motion +/- Calcium



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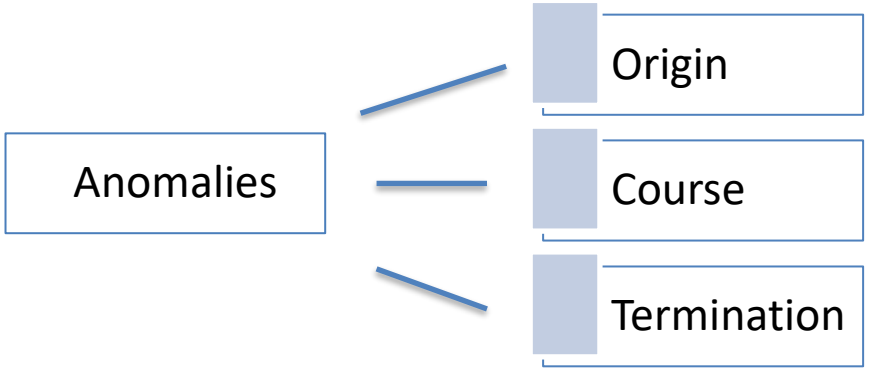
Coronary Anomalies

Prevalence 1-2%

Clinical presentation is variable; may remain occult or have life threatening consequences

Even if asymptomatic, knowledge of their presence is important at cardiac surgery



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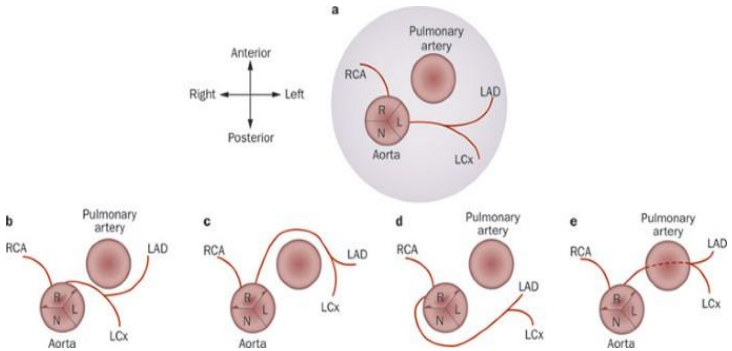
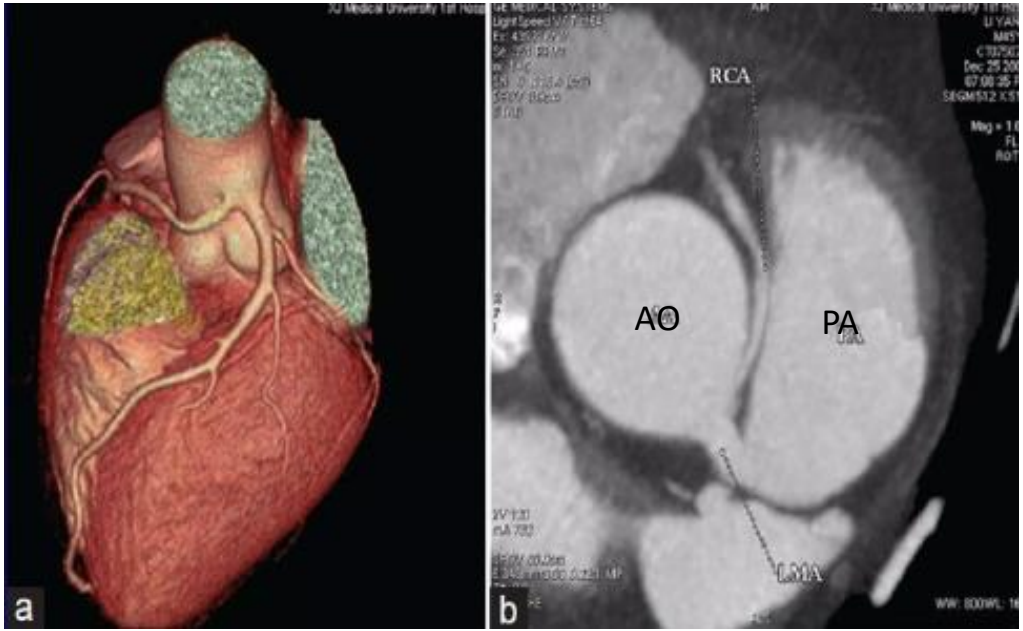
Inter-Arterial Course

- **Carries a risk of sudden cardiac death**
  - Narrow slit-like orifice
  - Acute angle of the ostium with tangential course
  - Intra-mural course





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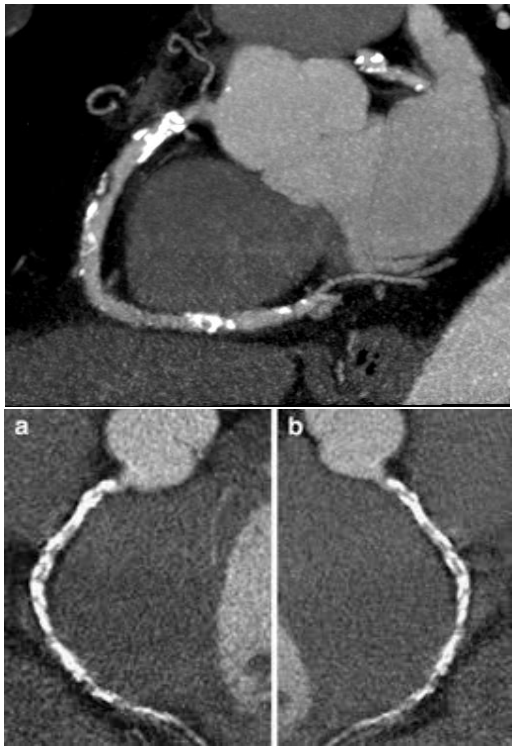
Plaque characterisation

Calcified



Non-calcified

Partially calcified

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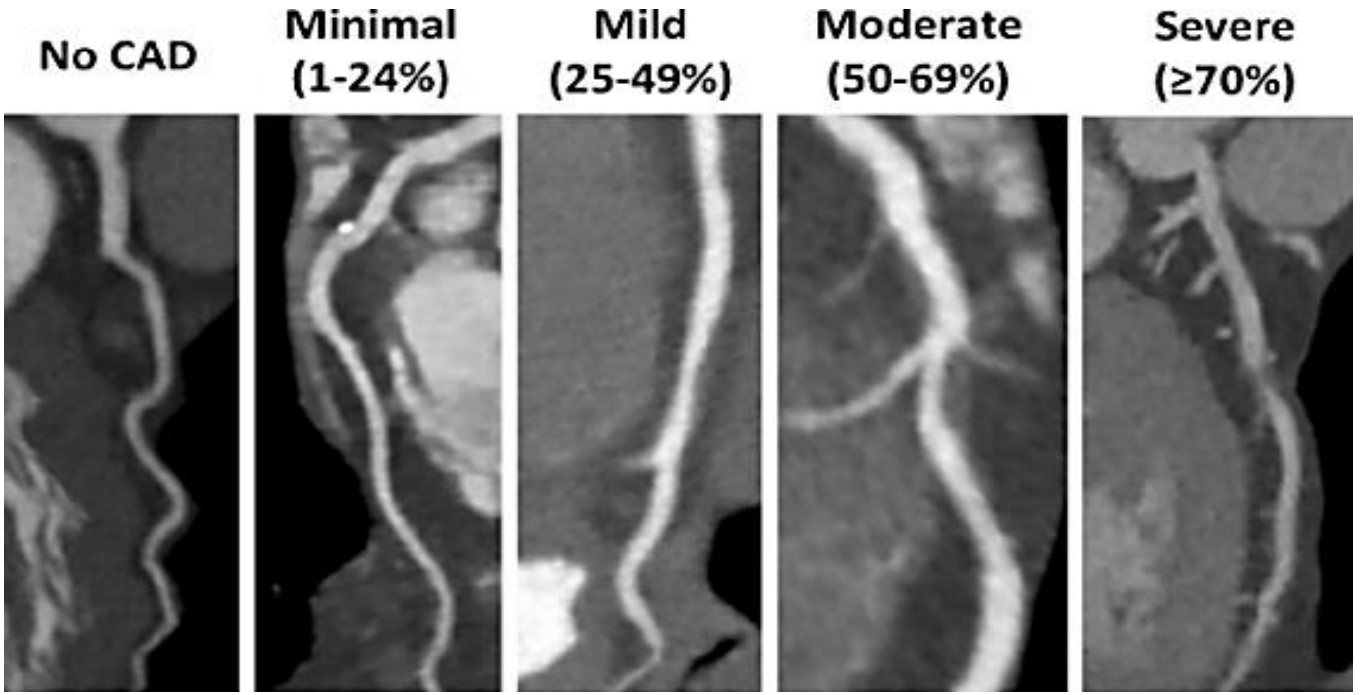
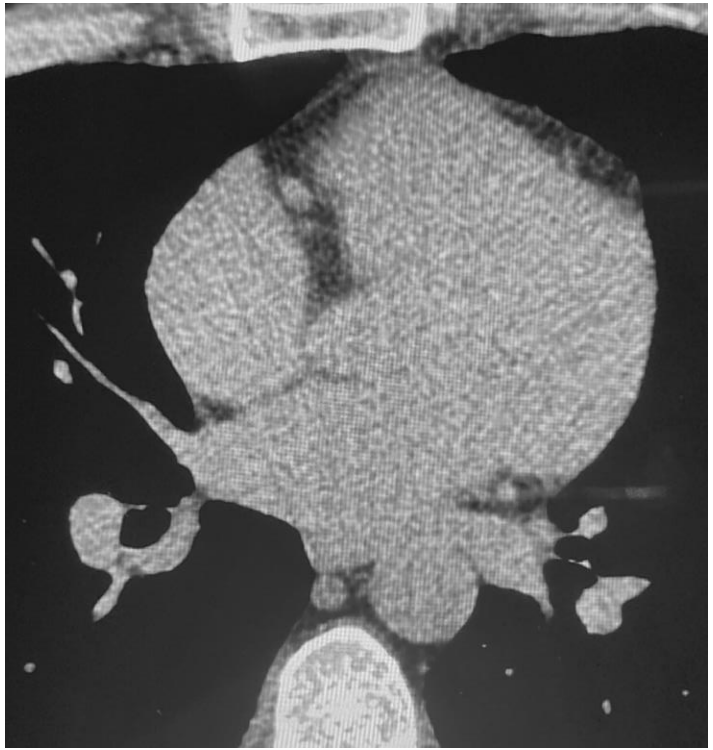
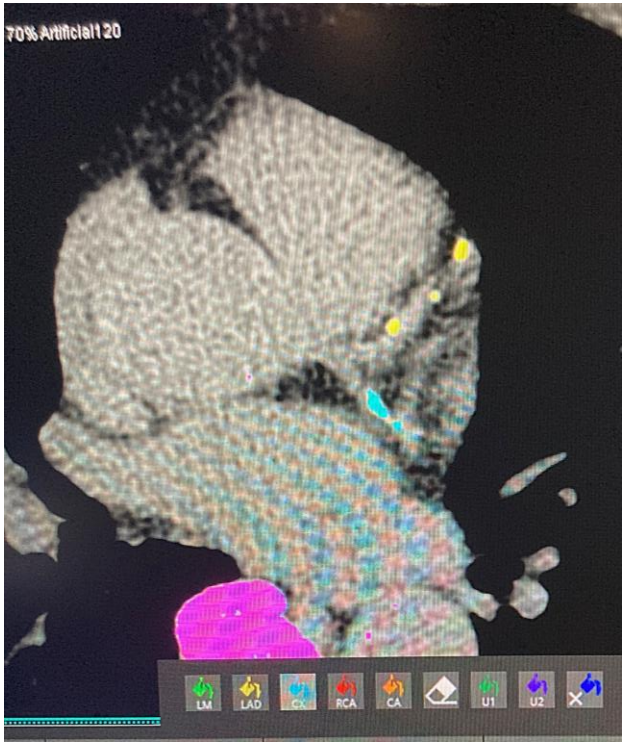
Grading Stenosis



Calcium Score





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The Role of Calcium Scoring (CAC)

Use a calcium score to screen patients with moderate (intermediate) Framingham risk

Positive CAC scores indicate incremental risk

Alters therapeutic goals

Improve Compliance

Coronary artery calcium scoring does NOT:

Predict exactly if you will have an MI

Provide detail of coronary artery stenosis

Serve as a substitute for a coronary angiogram or stress test

Not identify non calcified plaque

Back to MESA CAC

Input your age, select your gender and race/ethnicity, input (optionally) your observed calcium score and click "Calculate".

Age (45-84):	
Gender:	female
Race/Ethnicity:	black
Observed Agatston Calcium Score (optional):	

Calculate

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MESA The Multi-Ethnic Study of Atherosclerosis

The estimated probability of a non-zero calcium score for a white male of age 46 is 28 %.

Percentiles and Calcium Scores for: white male of age 46

25th	50th	75th	90th
0	0	3	48

The observed calcium score of 0.6 is at percentile 72

for subjects of the same age, gender, and race/ethnicity who are free of clinical cardiovascular disease and treated diabetes.

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Extra Cardiac Findings

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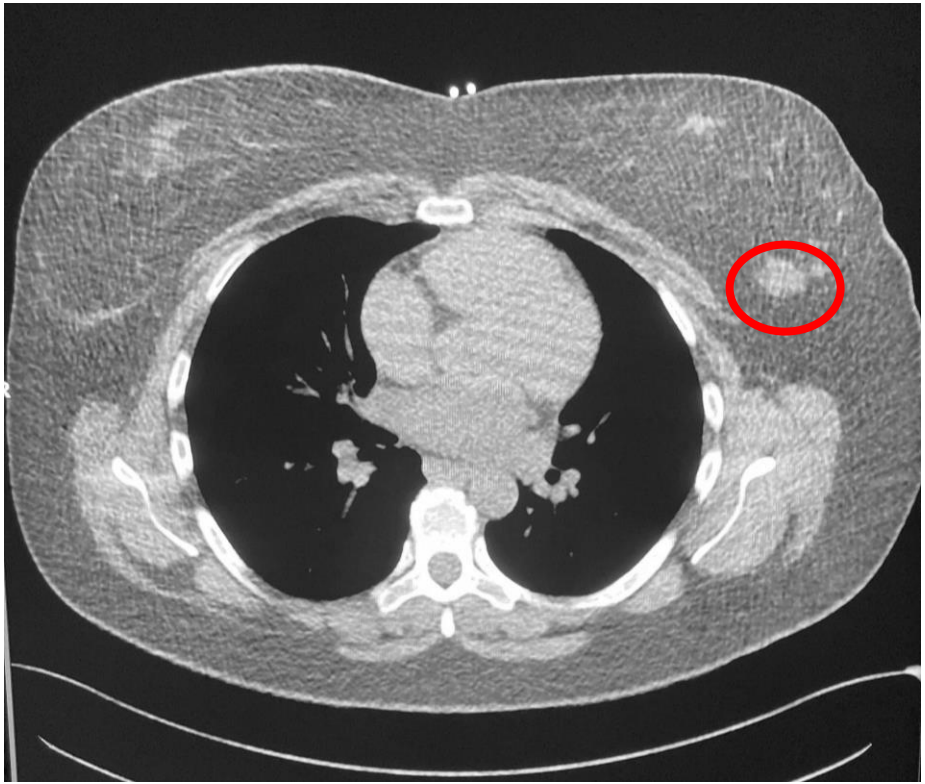
52 yr Old Atypical Chest Pain



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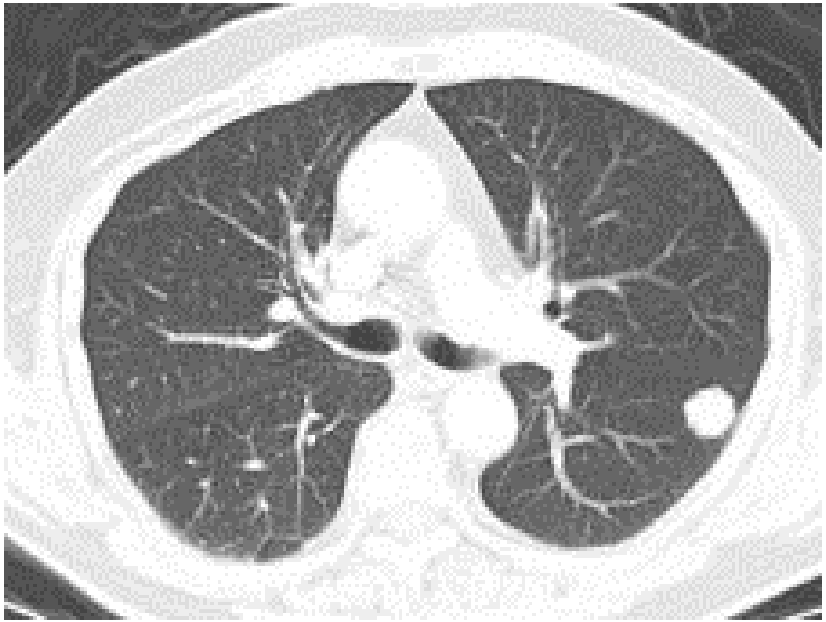
Pulmonary Nodules



Fleischner Guidelines

Solid	Size	Follow up		
	< 6 mm (<100mm^3)	Single	Low risk	No routine follow
			High risk	Optional CT at 12 months
		Multiple	Low risk	No routine follow
			High risk	Optional CT at 12 months
	6-8 mm (100-250mm^3)	Single	Low risk	CT at 6-12 mo, then consider CT at 18-24
			High risk	CT at 6-12 mo, then CT at 18-24
		Multiple	Low risk	CT at 3-6 mo, then consider CT at 18-24
			High risk	CT at 3-6 mo, then CT at 18-24
	> 8 mm (> 250mm^3)	Single	All	Consider CT at 3 mo, PET/CT or Biopsy
		Multiple	Low risk	CT at 3-6 mo, then consider CT at 18-24
			High risk	CT at 3-6 mo, then CT at 18-24

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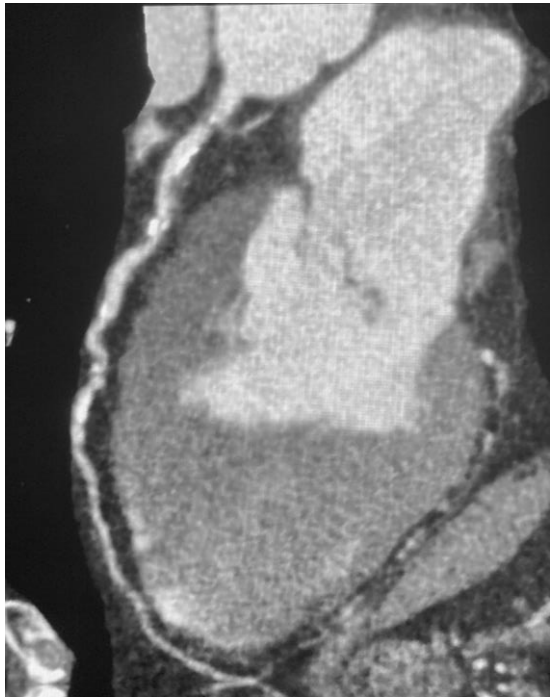
Case

52 yr old
smoker
+FHx

Referred
for CABG

LAD



LAD

RCA

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Case

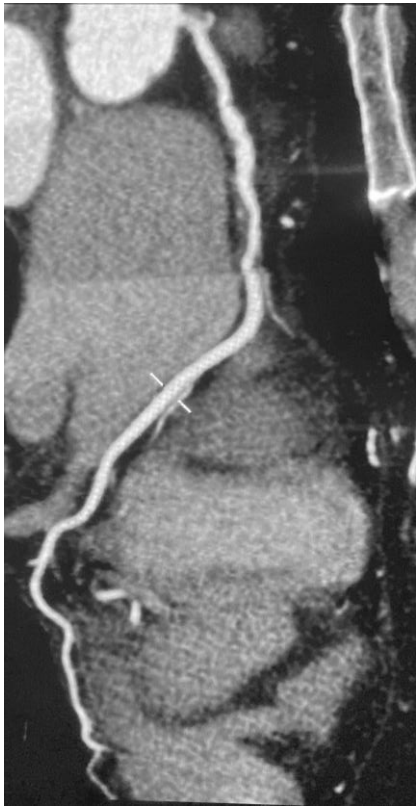
59 yr old
Chol 6.0
+FHx

Calcium score 0

Stenosis prox RCA 50-69% vulnerable features

LAD

RCA



RCA

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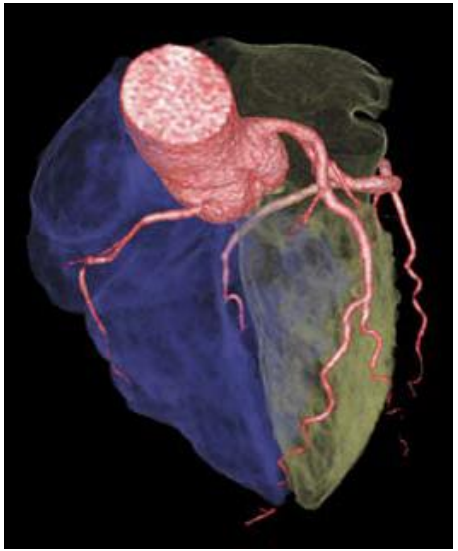
Conclusion

Patient Selection



Preparation is Vital for Accuracy

Take Report in a Clinical Context

Understand the Limitations

Thank you

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