Interpretation of cardiac CT

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Accuracy of CTA

Measure of Accuracy	Patient-Based Detection	
	Quantitative MDCTA (N=291)	Visual MDCTA (N=291)
AUC — median (95% CI)	0.93 (0.90–0.96)	0.93 (0.89–0.95)
Stenosis by CCA — no.	163	163
Stenosis by MDCTA — no.	152	146
False positive — no.	13	11
False negative — no.	24	28
Sensitivity — % (95% CI)	85 (79–90)	83 (76–88)
Specificity — % (95% CI)	90 (83–94)	91 (85–96)
Positive predictive value — % (95% CI)	91 (86–95)	92 (87–96)
Negative predictive value — % (95% CI)	83 (75–89)	81 (73–87)

NEJM 2008;359:2324

Arch Intern Med 2011;171:1021

Table 7. Center-Based Operating Characteristics of Computed Tomographic Coronary Angiography (≥50% Stenosis)

Variable	N	% (95% CI)				AUC
		Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	
Center-based diagnostic accuracy						
Center 1[a]	102	93.2 (80.3-98.2)	93.1 (82.5-97.8)	91.1 (77.9-97.1)	94.7 (84.5-98.6)	0.931
Center 2[a]	40	73.3 (44.8-91.1)	92.0 (72.4-98.6)	84.6 (53.7-97.3)	85.2 (65.4-95.1)	0.826
Center 3[a]	11	50.0 (17.4-82.6)	100 (31.0-100)	100 (40.0-100)	42.9 (11.8-79.8)	0.750
Center 4[a]	16	69.2 (38.9-89.6)	100 (31.0-100)	100 (62.9-100)	42.9 (11.8-79.8)	0.846
Centers 2, 3, and 4[b]	67	66.7 (48.9-80.9)	93.5 (77.2-98.9)	92.3 (73.4-98.7)	70.7 (54.3-83.4)	0.801

Guidelines

Appropriateness use criteria

Practice guideline

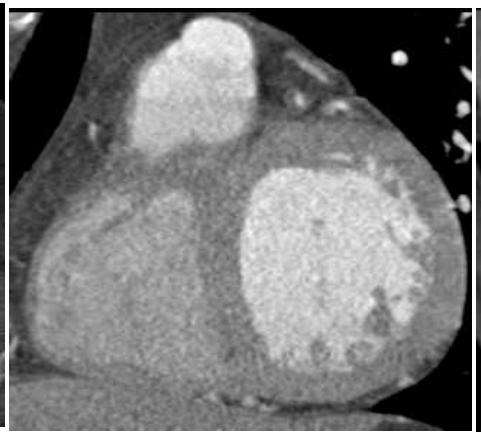
- ACR-NASCI-SPR practice parameter for the performance and interpretation o f cardiac computed tomography (2014 ammended)
- SCCT guidelines for performance of CCTA (2009)
- SCCT guidelines on radiation dose and dose-optimization strategies in cardio vascular CT
- **SCCT guidelines for the interpretation and reporting of CCTA (2014)**
- SCCT guidelines on the use of CCTA for patients presenting with acute chest pain to the emergency department

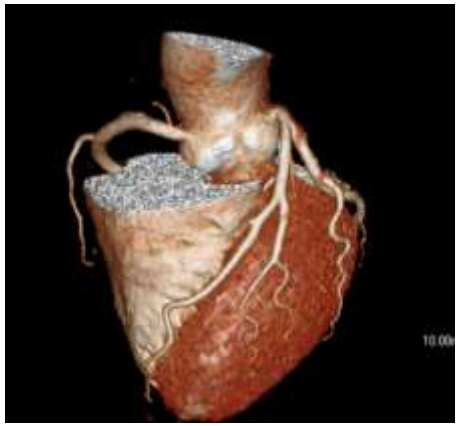
Other

- NICE guideline for new generation cardiac CT scanners

Interpretation formats

- Transaxial images
- Multiplanar reformation
- Maximum intensity projection
- Curved multiplanar reformation, 3DVR

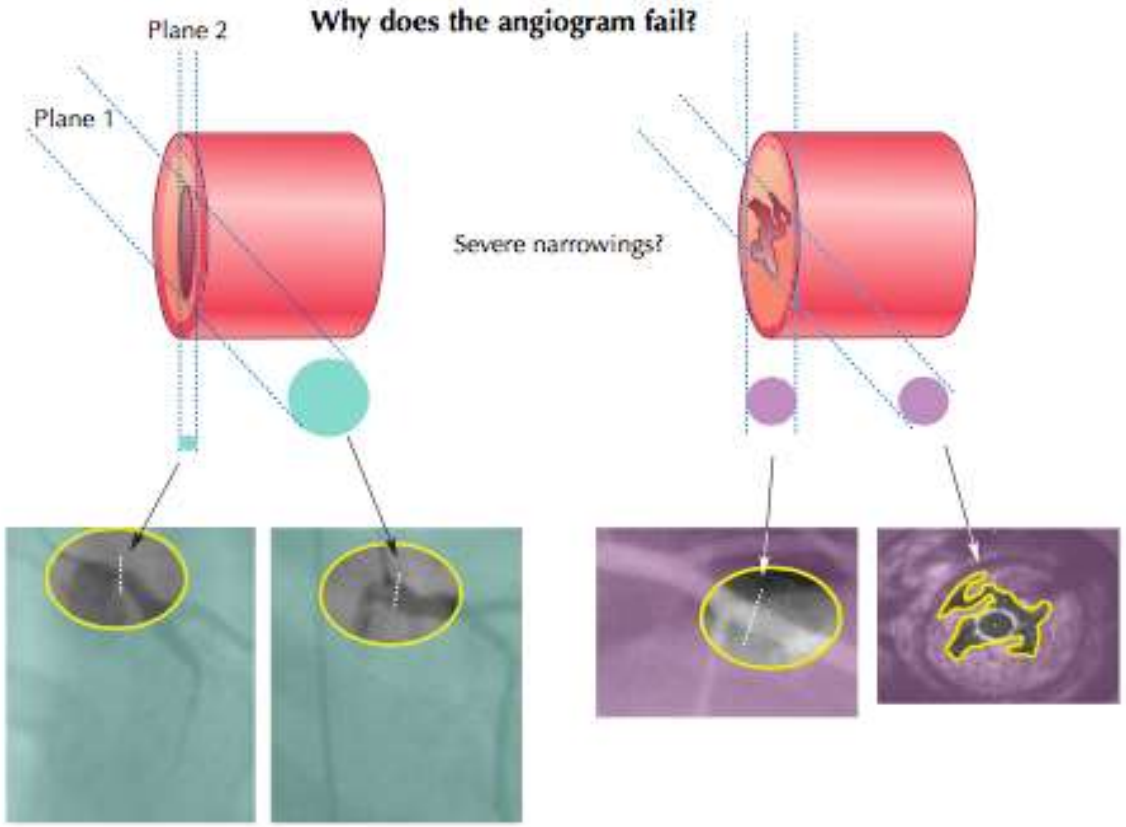




Interpretation

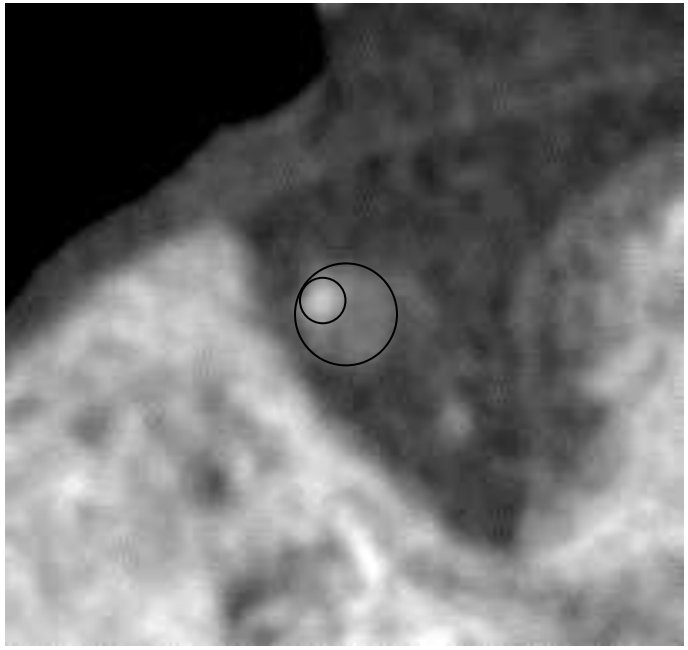
- Examination of image quailty
  - Reconstruction artifacts
  - Metal density artifacts
  - Reduced signal-to-noise and low vessel contrast intensity
- Coronary artery interpretation
  - Anatomy: anomaly, dominance, myocardial bridging
  - Coronary segmentation (location)
  - Analysis of coronary anatomy and pathology
  - Qualitative assessment of stenosis severity
  - Quantitative assessment of stenosis severity

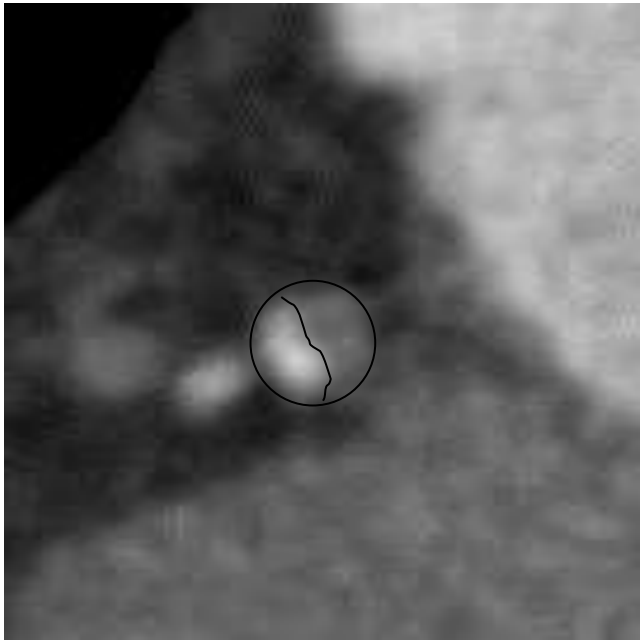
Why does the angiography fail to predic t physiology?



Kern et a. JACC 2010;55:173-85

Cross-sectional area stenosis





SCCT guideline for stenosis severity

0 - Normal: absence of plaque and no luminal stenosis

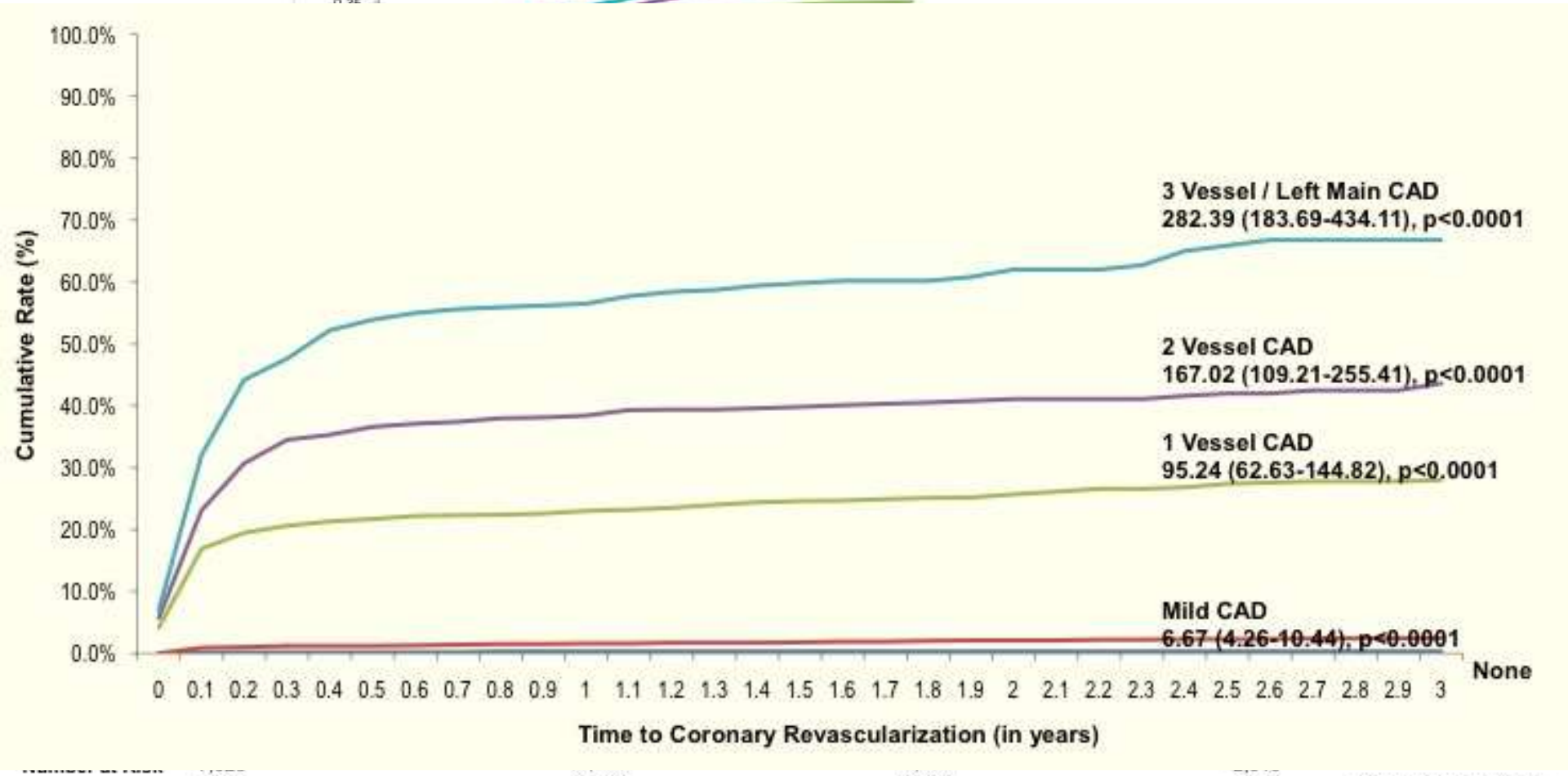
1 - Minimal: plaque with <25% stenosis

2 - Mild: 25% to 49% stenosis

3 - Moderate: 50% to 69% stenosis

4 - Severe: 70% to 99% stenosis

5 - Occluded



5,380	4,723	2,449	1,352
1,713	922	486	279
705	318	156	87
357	116	52	32

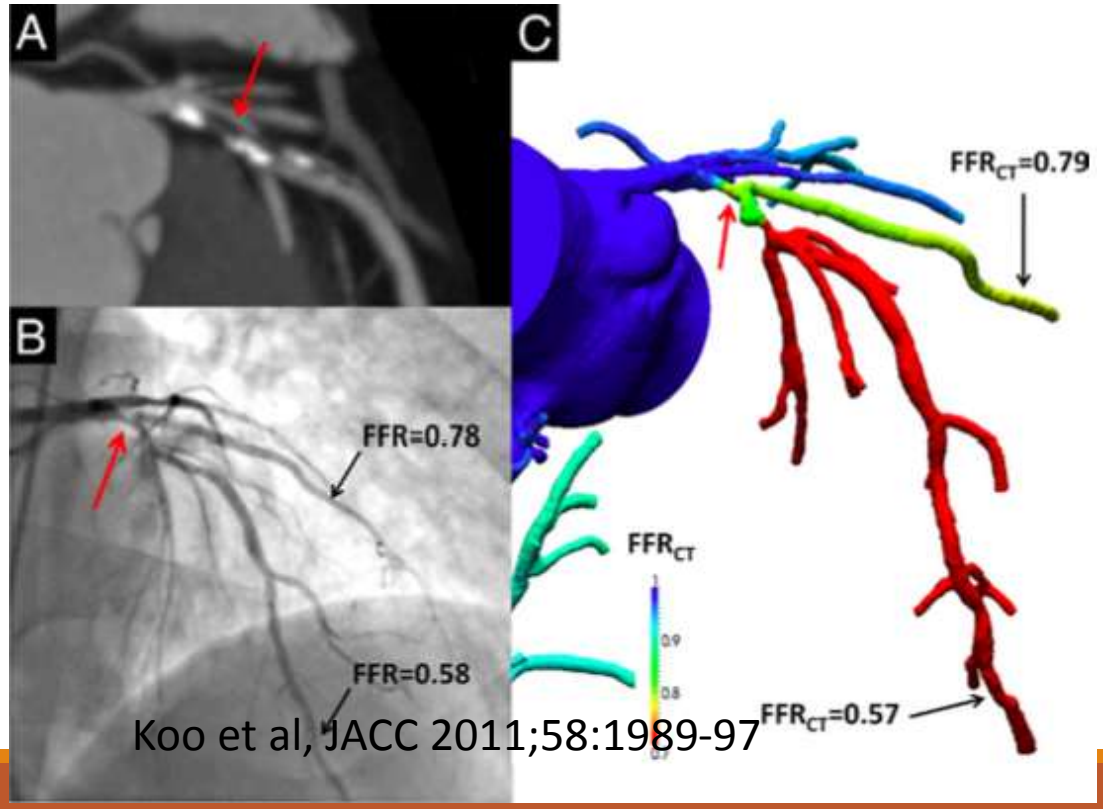
*Please note that the figure insert has a different y-axis from the main figure.

JACC 2012;60:2103-14

Issues for better gatekeeper role

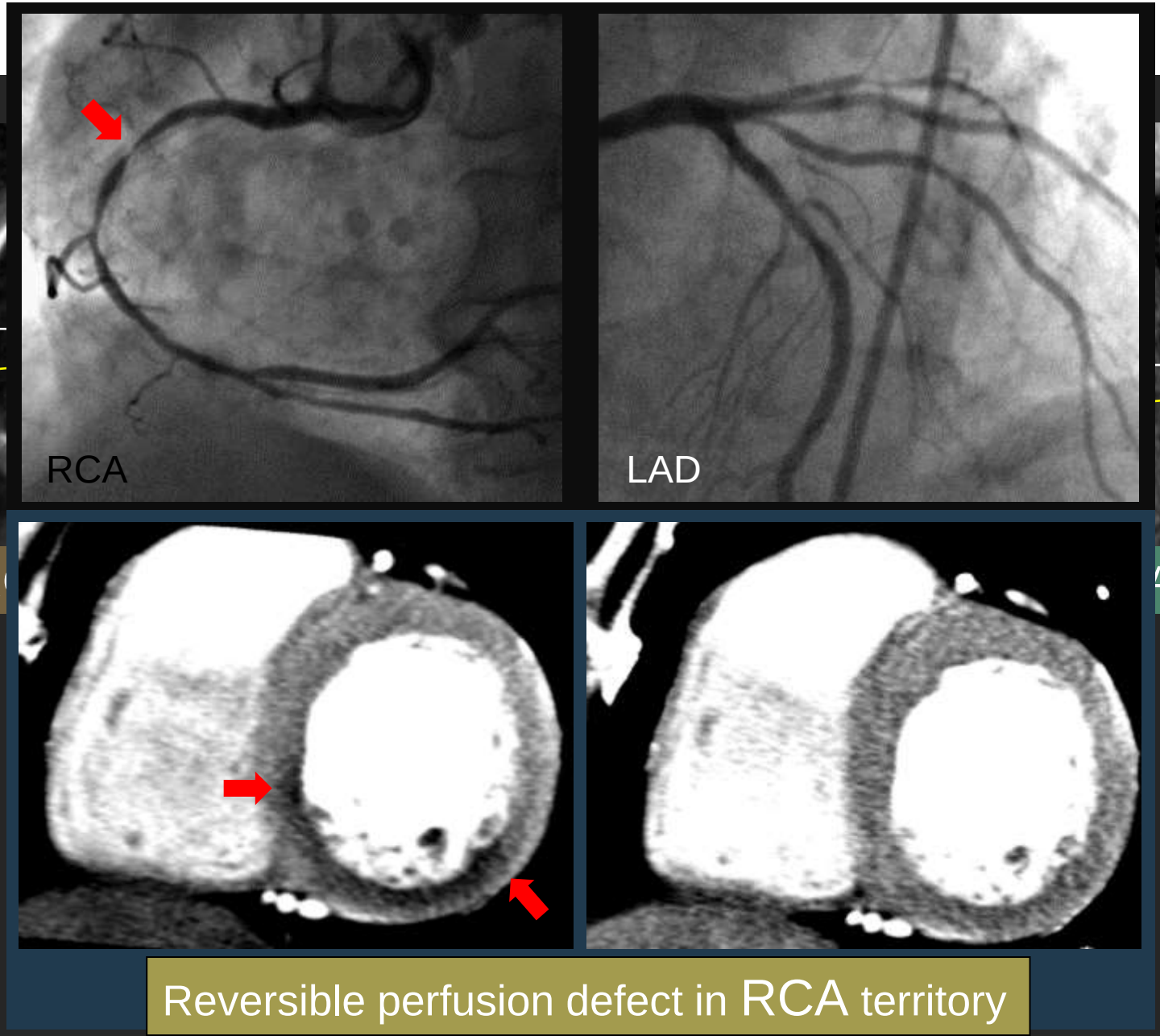
Still high false positive rate on segment-basis analysis

FFR-based revascularization strategy



Koo et al, JACC 2011;58:1989-97

Heavily calcified plaque



Reversible perfusion defect in RCA territory

CT Perfusion

- MDCT Integrated: 85%
- CMR Perfusion: 88%

Table 2 Comparison of Diagnostic Protocols in Predicting Functionally Significant CAD (FFR ≤0.80)

	CAD (%)	n	TP	TN	FP	FN	k	% Sensit. (95% CI)	% Specif. (95% CI)	% PPV (95% CI)	% NPV (95% CI)	+LR	−LR	% Accu. (95% CI)
Patient-based														
CTA alone	43.6	101	44	35	22	0	0.58	100 (92–100)	61 (55–61)	67 (61–67)	100 (89–100)	2.59	0.00	78 (71–78)
CTP alone	43.6	101	30	53	4	14	0.62	68 (58–74)	93 (85–98)	88 (75–96)	79 (72–83)	9.72	0.34	82 (73–87)
MDCT Int to Prot	43.6	101	39	47	10	5	0.70	89 (78–95)	83 (74–88)	80 (70–86)	90 (82–96)	5.05	0.14	85 (76–91)
CMR-Perf	43.6	101	39	50	7	5	0.76	89 (79–95)	88 (80–93)	85 (75–91)	91 (83–96)	7.22	0.13	88 (79–94)
Vessel-based														
CTA alone	24.1	303	69	155	75	4	0.47	95 (87–98)	67 (65–69)	48 (44–50)	97 (94–99)	2.90	0.08	74 (70–76)
CTP alone	24.1	303	40	219	11	33	0.56	55 (46–61)	95 (93–97)	78 (66–88)	87 (84–89)	11.46	0.47	85 (81–89)
MDCT Int-Prot	24.1	303	52	206	24	21	0.60	71 (62–79)	90 (87–92)	68 (59–76)	91 (88–93)	6.83	0.32	85 (81–89)
CMR-Perf	24.1	303	58	215	15	15	0.73	79 (71–86)	93 (91–96)	79 (71–86)	93 (91–96)	12.18	0.22	90 (86–93)

JACC 2013;61:1099

Current AUC for Cardiac CT

2013 Multimodality AUC for SIHD

2013 Appropriateness Criteria in Korea

2010 appropriate use criteria for cardiac computed tomography: a report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force

ASCI 2010 appropriateness criteria for cardiac computed tomography of the Asian Society of Cardiovascular Imaging

2006 appropriate use criteria from ACCF

Noninvasive coronary artery imaging: current clinical applications: Cardiac Society of Austrailia and New Zealand guidleines (CSANZ)

Chronic chest pain (ACCF 2010)

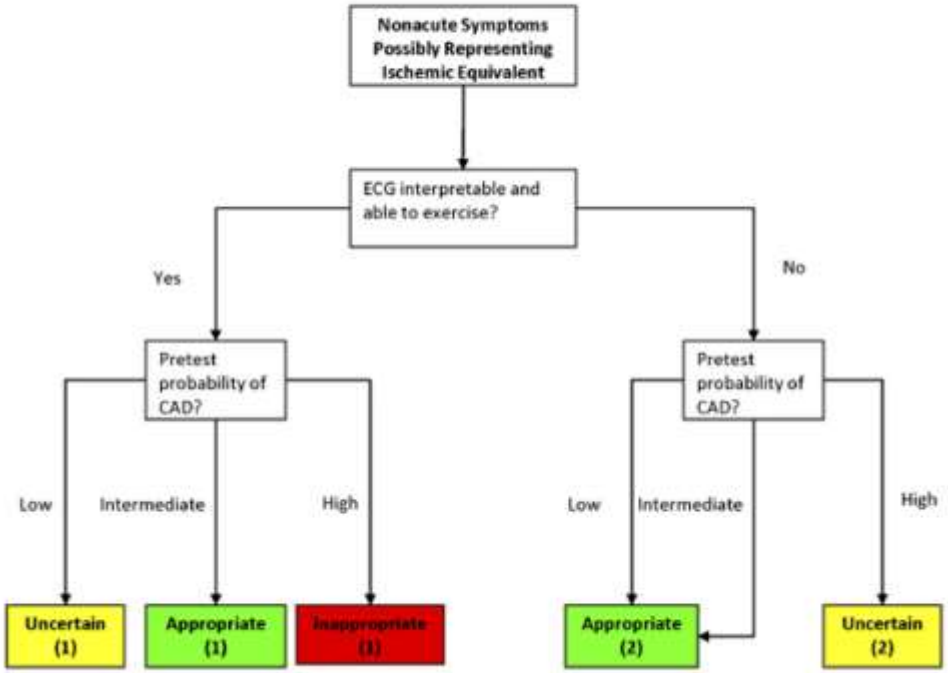


Figure 6. Detection of CAD in symptomatic patients without known heart disease symptomatic—nonacute presentation.

Use of CCTA for ACS at ER

Evidence by trials

- CT-STAT
- ROMICAT I & II
- ACRIN-PA

Benefits of CCTA

- Higher discharge rate
- Shorter length of stay
- Cost-effectiveness ?
- Not higher MACE ?

Acute chest pain: ACCF 2010

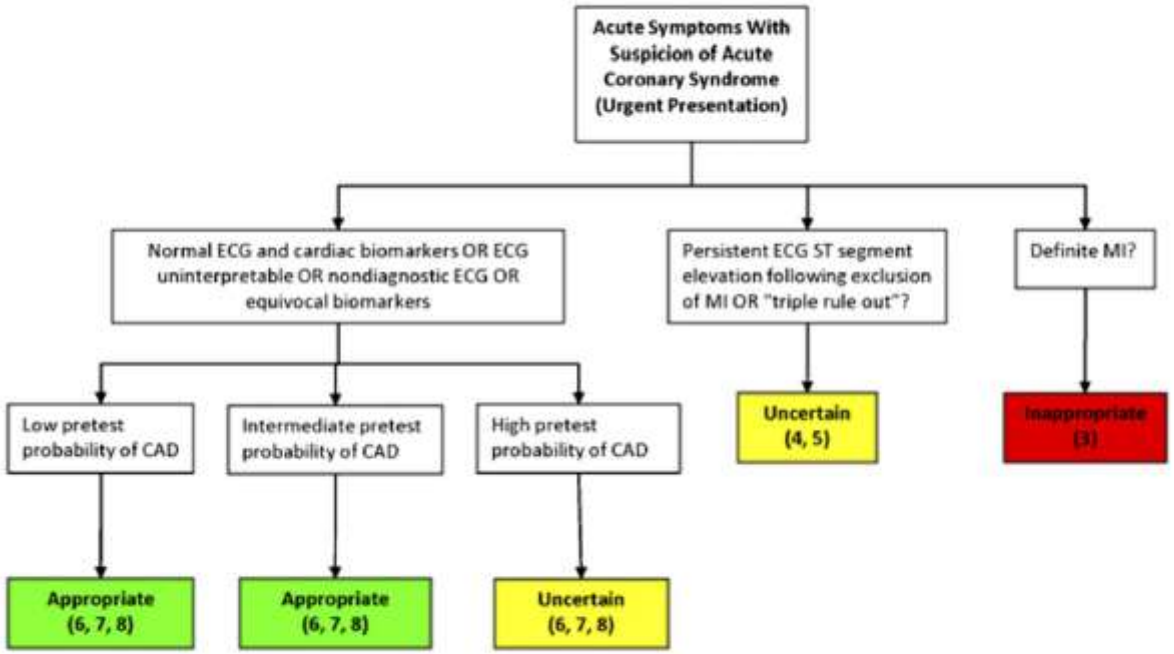
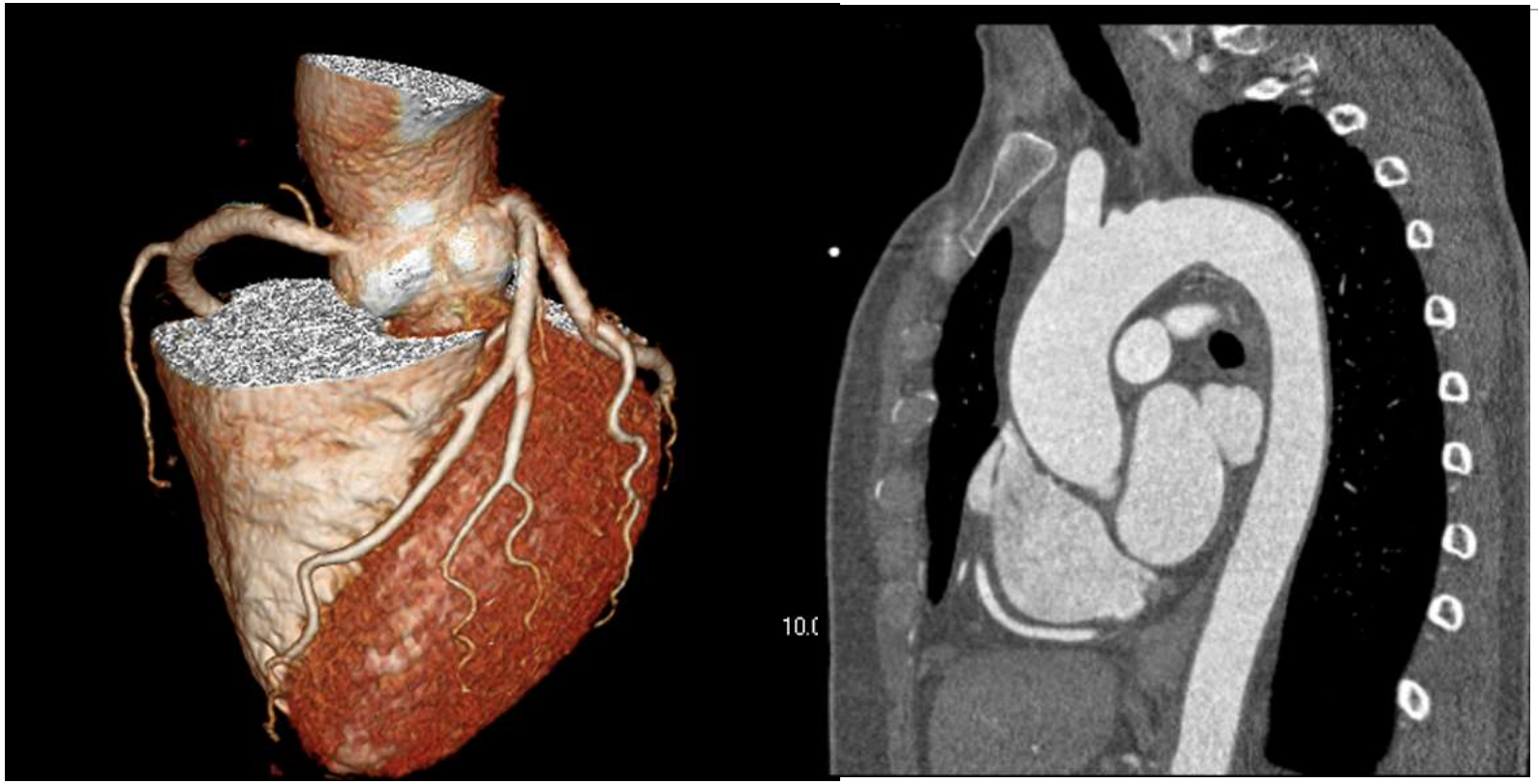


Figure 3. Detection of CAD in symptomatic patients without known heart disease symptomatic acute presentation.

F/51 atypical chest pain, DOE,
HR 46bpm, Flash mode (triple rule out)



Estimated radiation dose: 1.2mSv

Triple rule-out

2006 Criteria: Uncertain (4)

2008 Update in JCCT: Appropriate (7)

2010 Criteria: Uncertain (6)

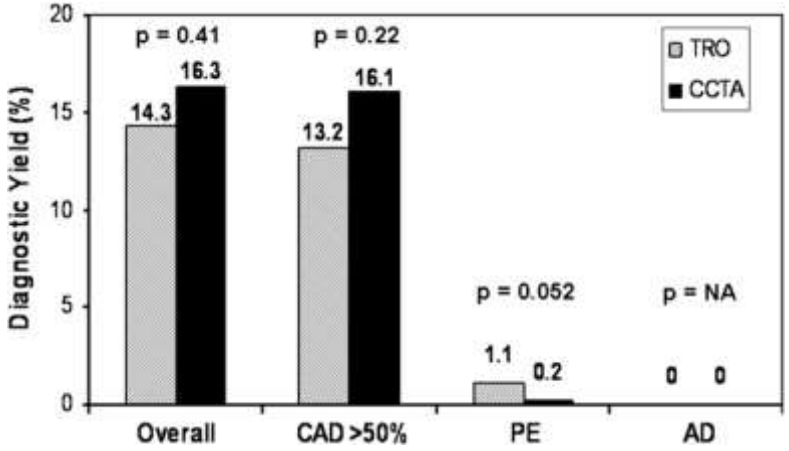
2010 ASCI Criteria: Appropriate (7)

2013 Korean AUC (7), LOE B

Triple rule-out

- Concerns
  - Diagnostic yield
  - Clinical outcome
  - Use of downstream resources
  - Radiation dose for covering whole thorax

DIAGNOSTIC YIELD



OUTCOME (TRO VS. CTA)

Use of Downstream resources
- More use in TRO group

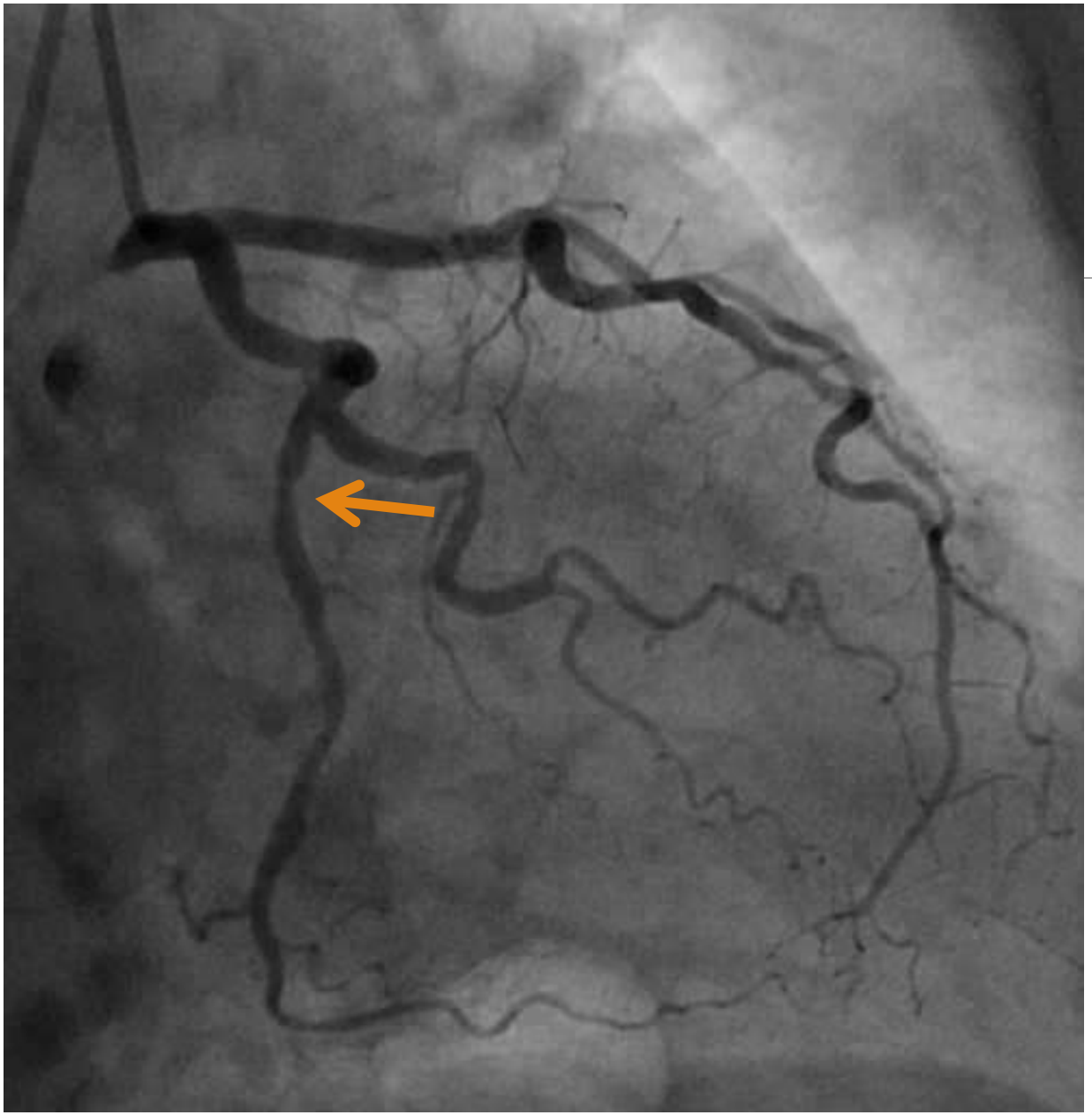
Length of stay:
- 8h12m vs. 7h38m

Costs: $1898 vs. $1724

Madder et al, J Cardiovasc Comput Tomogr 2011;5:165-71
Rogers et al, Am J Cardiol 2011;107:643-50

In comparison: ACP

Suspicion of ACS	Pre-test probability of CAD	ACCF 2006	ACCF 2010	ASCI 2010	KOREA 2013
Definite MI	-	I(1)	I(1)	I(3)	I (1) -C
Persistent ECG ST-segment elevation following exclusion of MI	-	-	U(6)	-	U (6) -B
TRO	-	U(4)	U(6)	A(7)	**A (7) -B**
Persistent probability of CAD	Low	U(5)	A(7)	U(4)	A (7) -A
	Intermediate	A(7)	A(7)	A(7)	A (7) -A
	High	U(6)	U(4)	A(7)	**A (7) –A***



MEDCOM RESAMPLED, Resample R(90.

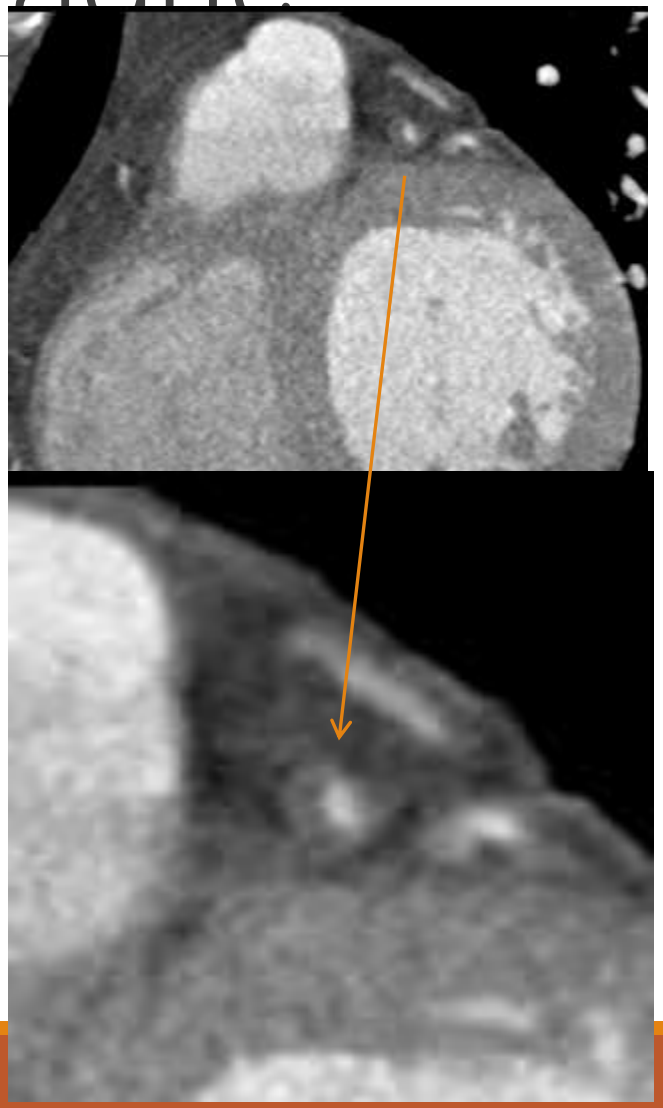
Coronary artery plaque

Detection

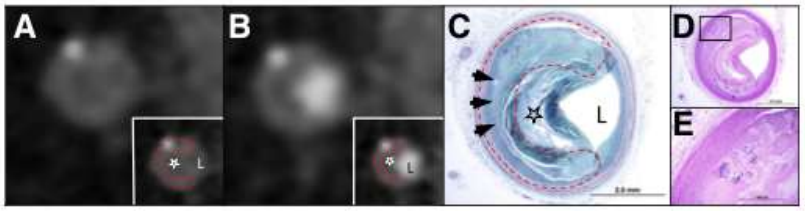
Description
- Calcified
- Noncalcified
- Mixed

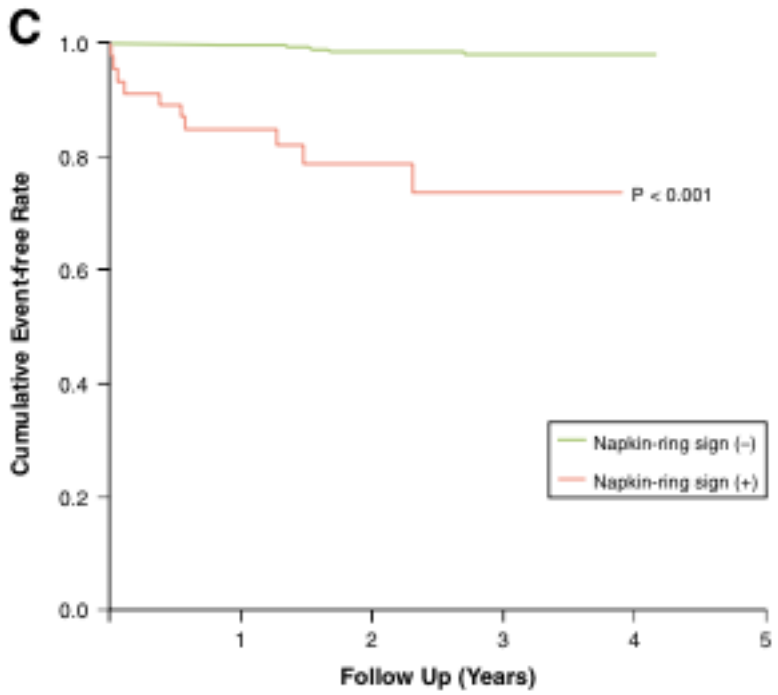
Quantification
- Area & volume
- Positive remodeling

Composition of Vulnerability
- Spotty Calcification
- Low attenuation
- Napkin ring sign

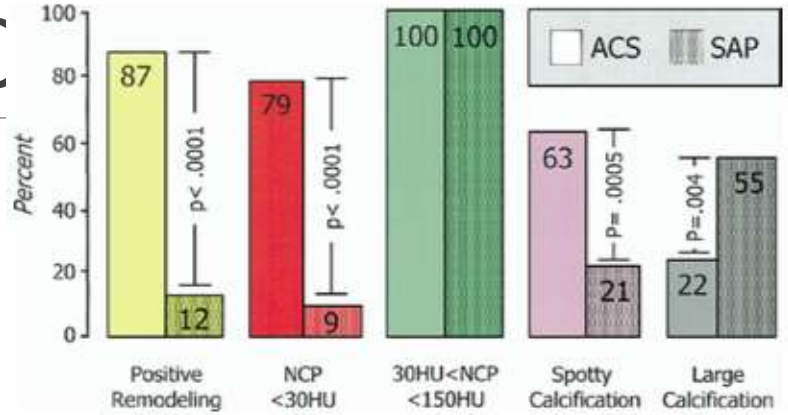


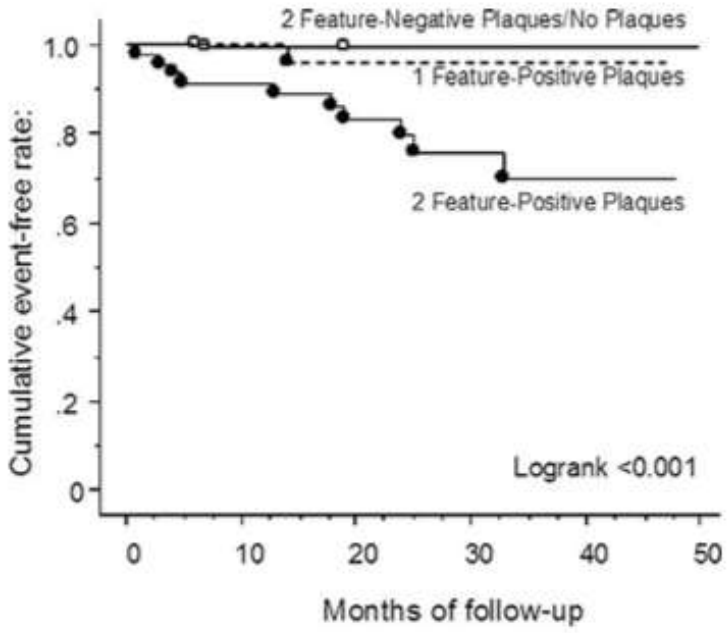
Vulnerable plac





JACC: Cardiovasc Imaging 2010;3:440-4 & 2013;6:448-57

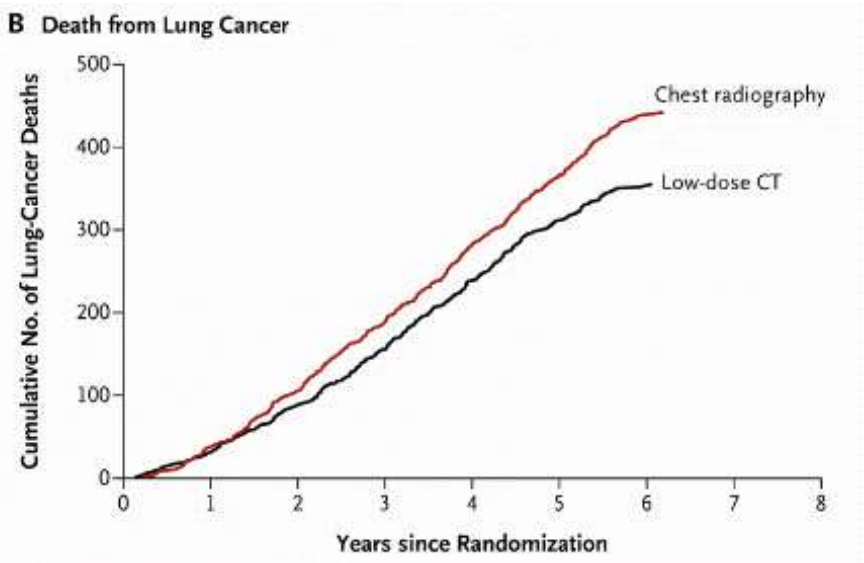




Motoyama et al, JACC 2007 & 2009

Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

National Lung Screening Trial



More than 50,000 people at high risk for lung cancer

- Low dose CT group (n=26722 pts) vs chest PA group (n=26732)
- Low-dose CT screening reduced lung cancer mortality 20%

N Engl J Med 2011; 365:395-409 , August 4, 2011

Choosing Wisely

Don't routinely order coronary computed tomography angiography for screening asymptomatic individuals. → **Appropriate in Asian Guideline! (for high risk)**

Don't use coronary computed tomography angiography in high risk* emergency department patients presenting with acute chest pain. → **Appropriate in Asian Guideline!**

Don't use coronary artery calcium scoring for asymptomatic patients with known coronary artery disease (including stents and bypass grafts).

Don't order coronary artery calcium scoring for preoperative evaluation for any surgery, irrespective of patient risk.

Don't order coronary artery calcium scoring for screening purposes on low risk asymptomatic individuals except for those with a family history of premature coronary artery disease.

Thank you!