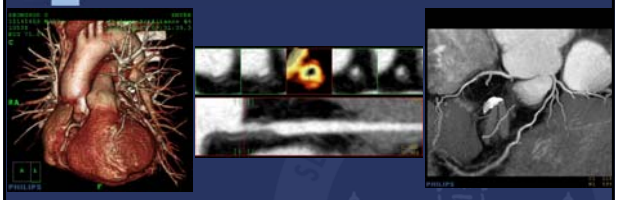
New clinical pathway for chest pain assessment: Role of Cardiac MDCT



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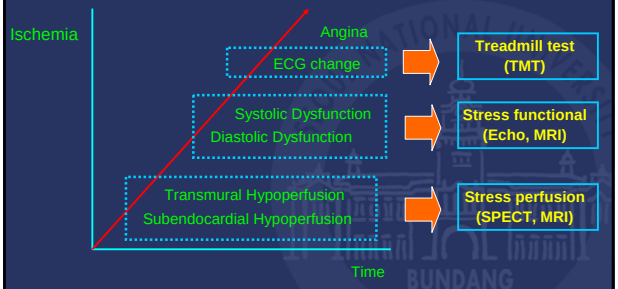
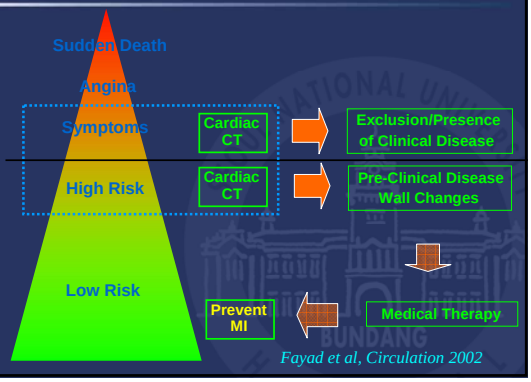
Seoul National University Bundang Hospital
College of Medicine Seoul National University

Ischemic Cascade



Potential clinical application



Fayad et al, Circulation 2002

Potential clinical application

- Atypical, symptomatic, chest pain
- Chest pain with equivocal stress test
- Preprocedural evaluation of chronic total occlusion
- Acute coronary syndrome
- Preoperative evaluation of coronary artery bypass graft or non-cardiac surgery at high risk patients
- Evaluation of stent patency
- Normal variation and congenital anomaly
- Asymptomatic patient for screening

MDCT in Atypical Chest Pain

- Significant number of noncardiac findings in cardiac MDCT:
  - new, noncaridac findings: 292/346 patients (58.1%)
  - clinically significant findings: 114/346 patients (22.7%)

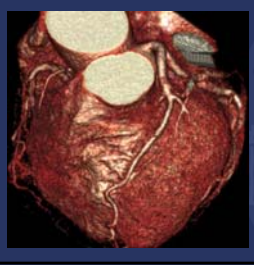
  Onuma Y. JACC 2006; 04.071v1.

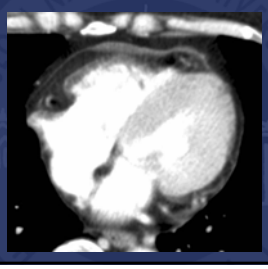
- Population having a low pretest likelihood of significant CAD:
  - moderate to high sensitivity and high NPV for the detection or exclusion of significant disease.

  Nikolaou K. AJR 2006; 186: 1659-1668

MDCT in Atypical Chest Pain

(M/61) Chest pain: continuous, radiating to the back
TMT and Holter: Normal
EchoCG: Normal
SPECT: Fixed defect at anterior wall (R/O Breast attenuation)

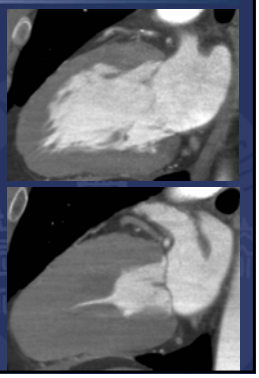




MDCT in Atypical Chest Pain

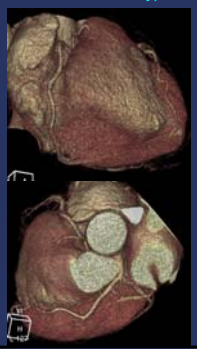
M/43, C.C: Atypical chest pain

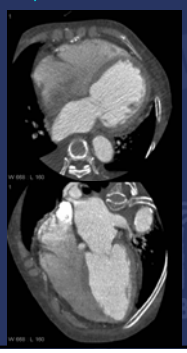
Hypertrophic Cardiomyopathy, Apical type

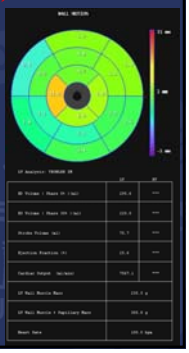


MDCT in Atypical Chest Pain

M/37, Atypical chest pain *Dilated CMP, EF = 25.6 %*







Potential clinical application

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- Chest pain with equivocal stress test
- Preprocedural evaluation of chronic total occlusion
- Acute coronary syndrome
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- Evaluation of stent patency
- Normal variation and congenital anomaly
- Asymptomatic patient for screening

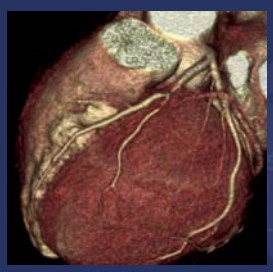
Chest pain with equivocal stress test

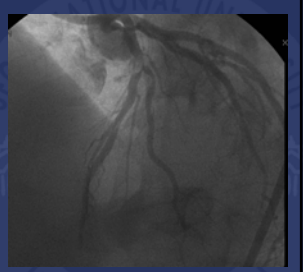
- Coronary CTA:
  - diagnosed obstructive CAD in a 1/4 of patients with negative TMT
  - excluded CAD in over half the patients with equivocal TMT.
- Coronary CTA is an excellent tool for improving diagnostic accuracy in patients with *chest pain, moderate pre-test probability of CAD and negative/ equivocal findings on TMT.*

Rubinstein R et al. ACC 2006; 807-6.

MDCT in negative TMT

Atypical Chest Pain
TMT: Normal





Chest pain with equivocal stress test

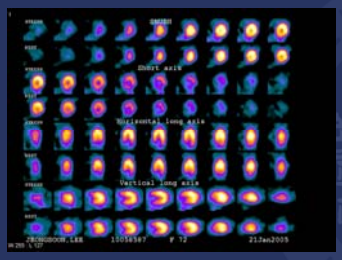
- A strategy that uses coronary CT angiography as a gatekeeper to catheterization is cost saving as opposed to initial catheterization for patients with *equivocal or mildly abnormal nuclear perfusion scans*.

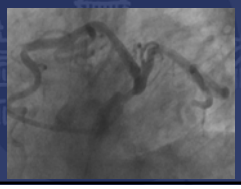
Cole JH et al . ACC 2006; 807-4.

MDCT in negative SPECT

F/72, Dyspnea (onset: 2 month),
EchoCG: Normal, SPECT: Normal

Left main: 80% stenosis

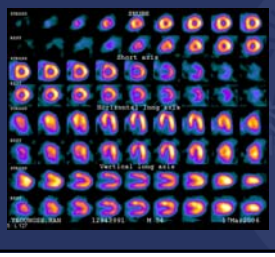


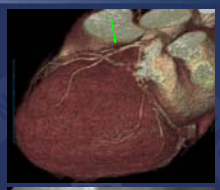


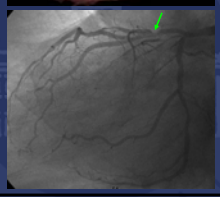
MDCT in negative TMT and SPECT

DOE: FC II
TMT: Normal
SPECT: No perfusion defect

pLAD: 75% stenosis







Potential clinical application

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MDCT in Chronic Total Occlusion

** Independent predictors of procedural failure for percutaneous revascularization

- Blunt stump (by conventional angiography)
- Occlusion length: > 15 mm
- Severe calcification (by CT angiography)

Mollet NR et al. Am J Cardiol 2005:95:240-243

MDCT in Chronic Total Occlusion

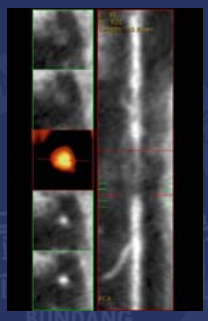
Additional information of CT angiography

- 3-dimensional length measurement of coronary segment
- Evaluation of the morphology of the occlusion trajectory

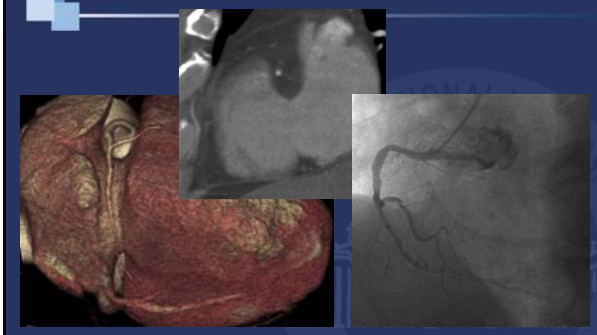
** difficulty of measurement by conventional angiography: foreshortening, calibration limitation, lack of visualization of distal vessel in the absence of collateral filling

Mollet NR et al. Am J Cardiol 2005:95:240-243

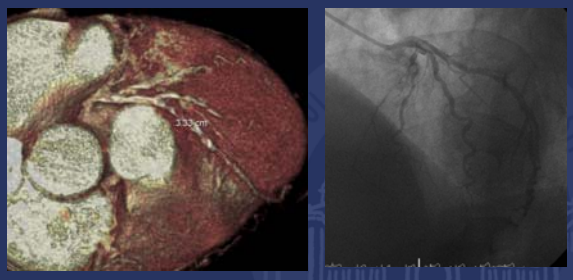
MDCT in Chronic Total Occlusion



MDCT in Chronic Total Occlusion



MDCT in Chronic Total Occlusion



Potential clinical application

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MDCT in Acute coronary syndrome

- Simultaneous assessment of CAD and global/ regional LV function.
- High accuracy of CT angiography in excluding significant CAD and in assessing LV function.
- Potential clinical use for screening of patients who present with symptoms of unstable angina.

Dirksen MS et al. Am J Cardiol 2005:95:457-461

MDCT in Acute coronary syndrome

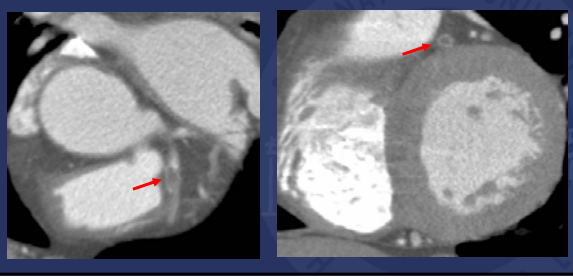
MDCT	CAG			
	MM	PCI	CABG	Total
MM	3	0	0	3
PCI	3	12	0	15
CABG	0	0	4	4
Total	6	12	4	22

- MM: Medical management, PCI: Percutaneous coronary intervention, CABG: coronary artery bypass graft.

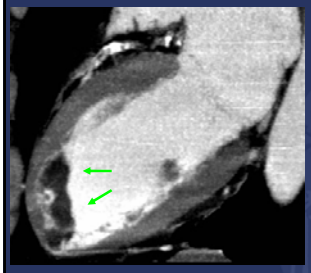
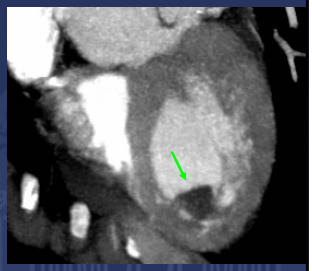
Dorgelo J et al. Eur Radiol 2005:15:708-713

MDCT in Acute coronary syndrome

Acute atypical chest pain
Normal ECG and cardiac Enzyme
NSTEMI: pLAD



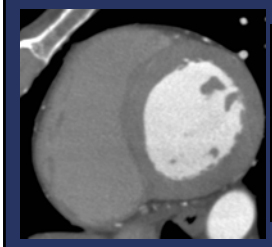
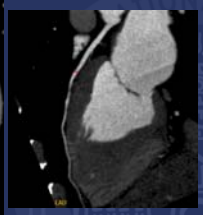
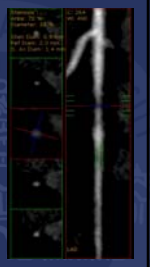
Cardiac Thrombus

DH Kim, SI Choi et al. JCAT 2006

MDCT in Acute coronary syndrome

Lt. chest pain (squeezing pain, radiation to back)
ECG : T-wave inversion at V2-4
CK/CK-MB/TnI : 45/0.2/0.08

TJ Yoon, SI Choi et al. Eur Radiol (Submitted)

MDCT in Acute coronary syndrome

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ECG : T-wave inversion at V2-4
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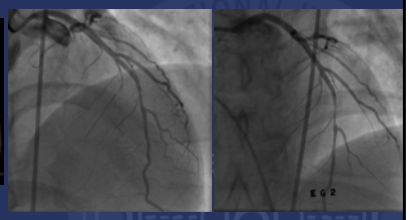


TJ Yoon, SI Choi et al. Eur Radiol (Submitted)

MDCT in Acute chest pain

- CTA can rapidly and definitely exclude CAD as the cause of acute chest pain.
- Immediate CTA reduces length of stay and cost of care without increasing risk *(64 MDCT)*.

Raff GL et al. ACC 2006: 807-8

- MDCT as a first diagnostic approach to acute chest pain:
  - can reduce the unnecessary admission
  - possibly reduces the length of hospital stay in patients with clinically low and intermediate risk of CAD *(64 MDCT)*.

SA Jang et al. 50th Annual Meeting of the Korean Society of Circulation #125

MDCT in Acute Chest Pain

- Promising comprehensive method for evaluating cardiac and noncardiac chest pain in stable emergency department *(16 MDCT)*.

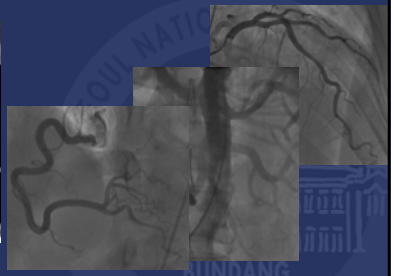
White CS et al. Am J Radiol 2005:185:533-540

"Triple Rule Out"

***** Acute coronary syndrome, Aortic dissection, Pulmonary embolism *****

"Triple Rule Out"

M/41, Acute chest pain
ECG: LBBB, V1~V4 ST elevation, hyperacute T wave,T-wave inversion on Lead I,II
R/O STEMI, Aortic dissection → R/O Acute pancreatitis

***** Intramural Hematoma with Overt Aortic Dissection *****

Potential clinical application

- Atypical, symptomatic, chest pain
- Chest pain with equivocal stress test
- Preprocedural evaluation of chronic total occlusion
- Acute coronary syndrome
- Preoperative evaluation of coronary artery bypass graft or non-cardiac surgery at high risk patients
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The Merit of CTA for planning of CABG

- Calcified plaque at target vessels
- Myocardial bridging
- Epicardial fatty tissue

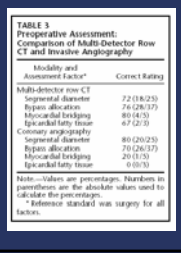
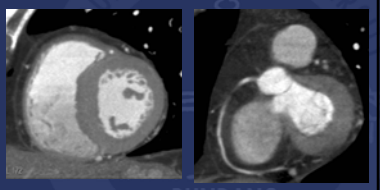


TABLE 3
Preoperative Assessment: Comparison of Multi-Detector Row CT and Invasive Angiography

Modality and Assessment Factor*	Correct Rating
Multi-detector row CT	
Segmental diameter	72 (18/25)
Bypass allocation	74 (28/37)
Myocardial bridging	80 (4/5)
Epicardial fatty tissue	67 (2/3)
Coronary angiography	
Segmental diameter	80 (20/25)
Bypass allocation	70 (26/37)
Myocardial bridging	20 (1/5)
Epicardial fatty tissue	0 (0/3)

Note.—Values are percentages. Numbers in parentheses are the absolute values used to calculate the percentages.
* Reference standard was surgery for all factors.



Herzog et al. Radiology 2003;229:200-208

Potential clinical application

- Atypical, symptomatic, chest pain
- High risk patient with equivocal stress test
- Preprocedural evaluation of chronic total occlusion
- Acute coronary syndrome
- Preoperative evaluation of coronary artery bypass graft or non-cardiac surgery at high risk patients
- Evaluation of stent patency
- Normal variation and congenital anomaly

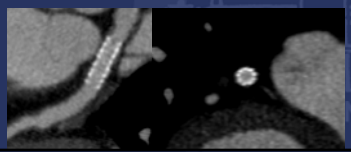
Evaluation of Stent Patency

Author	Journal	Assessable	Sensitivity	Specificity
Schuijf JD	Am J Cardiol 2004	70%	78%	100% (patency)
			75%	96% (restenosis)
Gilard M	Am J Cardiol 2005			
	Left main	100%	100%	92% (restenosis)
Gilard M	Heart 2006			
	> 3.0 mm	81%	86%	100% (restenosis)
	< 3.0 mm	51%	54%	100% (restenosis)

16-Slice MDCT

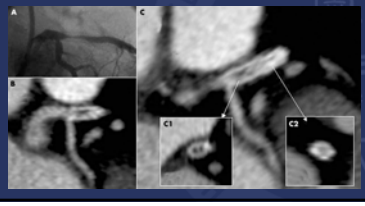
Evaluation of Stent Patency

Author		Sensitivity	Specificity	PPV	NPV
Gaspar T	JACC 2005	88.9%	80.6%	47.1%	97.4%
					40-slice MDCT
Carlos AG	Circulation 2006	100%	91%	67%	100%
	Left main				*16 and 64 MDCT*



Evaluation of Stent Patency

- Left main
- Stent diameter: > 3.0 mm
- Strut thickness: < 140 micro
- Instent restenosis: > 35%
- Stainless steal



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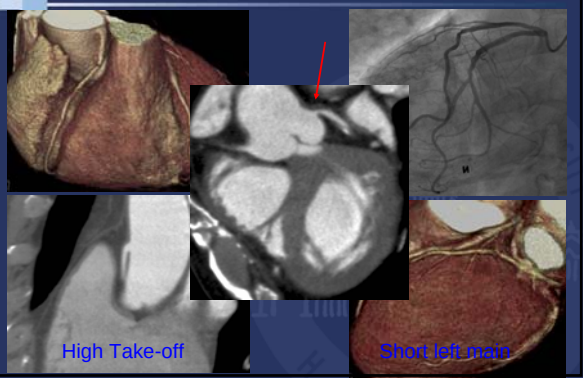
Anomaly or Variation of Coronary Artery

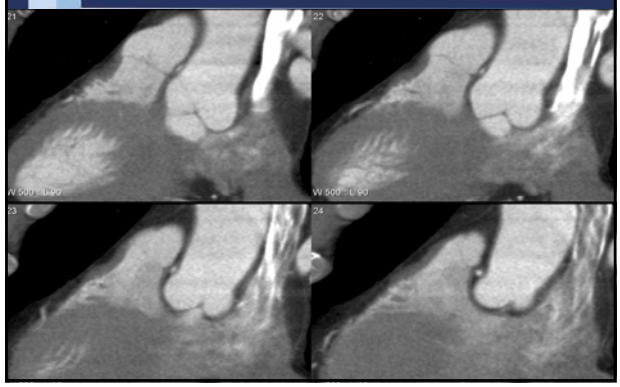
- Coronary CTA is a viable noninvasive modality in the delineation of coronary arterial anomalies, particularly if *results of coronary angiography are equivocal*.
- Coronary CTA is valuable for depicting the relationships among the coronary vessel, great vessels, and ventricles.

Datta J et al. Radiology 2005; 235: 812-818

Anomaly or Variation of Coronary Artery



Anomalous Origin of Coronary Artery



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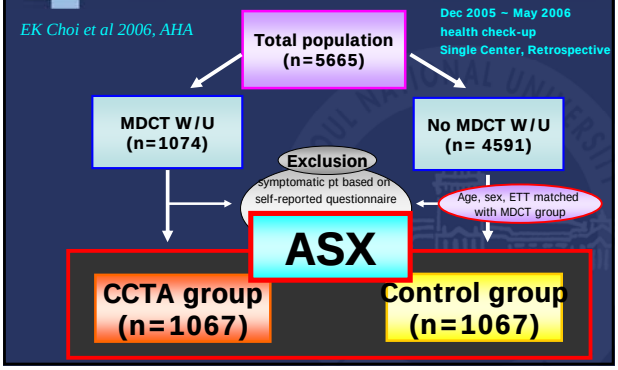
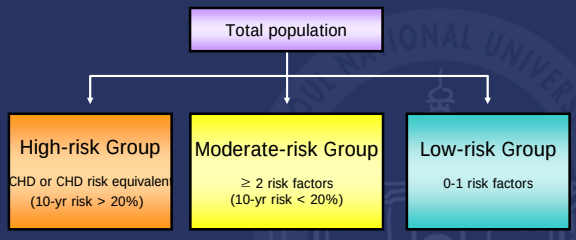
Coronary CTA: Screening test in Asymptomatic patient ?

EK Choi et al 2006, AHA



Coronary CTA: Screening test in Asymptomatic patient ?

Risk Stratification according to NCEP guideline

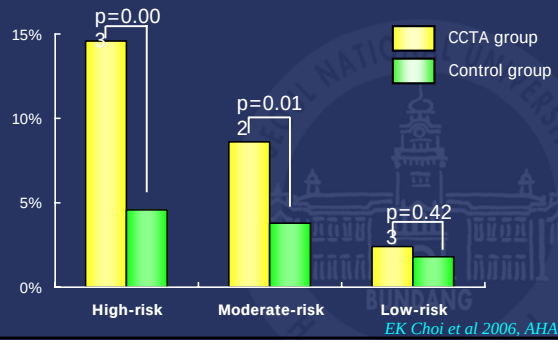


Risk factors: cigarette smoking, hypertension(BP≥140/90mmHg or antihypertensive medication), low HDL cholesterol (<40mg/dL), family history of premature CHD(CHD in male first-degree relative < 55 years of age; CHD in female first-degree relative < 65 years of age), and age (men ≥ 45 years; women ≥ 55 years)

EK Choi et al 2006, AHA

Coronary CTA: Screening test in Asymptomatic patient ?

Comparison of Referral Patterns



EK Choi et al 2006, AHA

Coronary CTA: Screening test in Asymptomatic patient?

- Revascularization 시행 여부
  - CCTA group = 15/1067 (1.4%),
    Control group = 2/1067 (0.1%)

Asymptomatic patient with moderate to high risk (CT군):
12/428 (2.8%) → Prophylactic Revascularization !!!

- Even in asymptomatic population, especially those with moderate to high risk group, CCTA had a significant impact on screening and managing occult CAD.

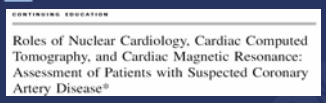
EK Choi et al 2006, AHA

Coronary CTA: New Paradigm ?

- Should coronary CTA it be used as a first test for the evaluation of chest pain or as a complementary test in patients with equivocal stress test results ?
- Should coronary CTA be used as a screening test in asymptomatic patients at risk ?
- The potential value of atherosclerotic plaque assessment by coronary CTA could provide to be useful in guiding preventive and therapeutic strategies.

Garcia MJ. JAMA 2005; 293: 2531 - 2533.

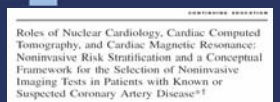
Coronary CTA: New Paradigm ?


Roles of Nuclear Cardiology, Cardiac Computed Tomography, and Cardiac Magnetic Resonance: Assessment of Patients with Suspected Coronary Artery Disease*

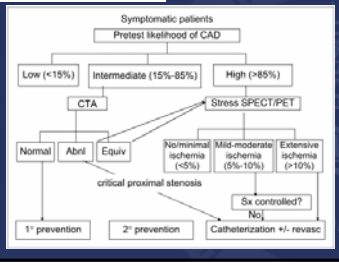
Bermann et al.
J Nucl Med 2006; 47: 74-82

- Coronary CTA may emerge as the initial test of choice.
- SPECT would then be used if the CTA is inconclusive or if there is a need to assess the functional significance of a stenosis defined by CTA.
- In older patients with a high likelihood of CAD, SPECT may be the initial test of choice, since a high proportion of these patients have too much coronary calcium.

Coronary CTA: New Paradigm ?


Roles of Nuclear Cardiology, Cardiac Computed Tomography, and Cardiac Magnetic Resonance: Noninvasive Risk Stratification and a Conceptual Framework for the Selection of Noninvasive Imaging Tests in Patients with Known or Suspected Coronary Artery Disease*†

Bermann et al.
J Nucl Med 2006; 47: 1107-1118



Coronary CTA: New Paradigm ?

Modality	Cost	Time	Sensitivity
TMT	36,000원	20 min	50%
Stress EchoCG	400,000원	30 min	82%
SPECT	600,000원	4 hour	90%
M R I	750,000원	1 hour	90%
P E T	700,000원	2 hour	90%
CT	300,000원	10 min	95%

New Paradigm for the Evaluation of Ischemic Heart Disease in the Era of Cardiac MDCT and MRI

- Asymptomatic, but moderate to high risk patient - CT (first line)
- Symptomatic, but atypical chest pain - CT (first line)
- Stable angina without dysfunctional myocardium - CT (first line)
- Stable angina with dysfunctional myocardium
  - MRI (complementary)
- Stable angina with multi-vessel disease - MRI (complementary)
- Microvascular angina (Syndrome X or Women's Heart Syndrome)
  - CT (first line) or MRI (first line or complementary imaging)
- Acute coronary syndrome (unstable angina, NSTEMI)
  - CT (first line imaging)
- Acute coronary syndrome (STEMI) - MRI (complementary)
- Chronic myocardial infarction with dysfunctional myocardium
  - MRI (first line or complementary imaging)

Thank you for your Attention!!

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