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

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Potential clinical application

MDCT in Atypical Chest Pain

• Significant number of noncardiac findings in cardiac MDCT:
  - new, noncardiac 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.

  Nikoloua K. AJB 2006; 186: 1658-1668

Potential clinical application

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)
Potential clinical application

- Atypical 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

Chest pain with equivocal stress test

- Coronary CTA:
  - diagnosed obstructive CAD in 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 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

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
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MDCT in negative TMT and SPECT
DOE: FC II
TMT: Normal
SPECT: No perfusion defect
pLAD: 75% stenosis

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)

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

Potential clinical application

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

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.


<table>
<thead>
<tr>
<th>MDCT</th>
<th>CAG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MM</td>
</tr>
<tr>
<td>MM</td>
<td>3</td>
</tr>
<tr>
<td>PCI</td>
<td>3</td>
</tr>
<tr>
<td>CABG</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
</tr>
</tbody>
</table>

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

Cardiac Thrombus

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

Lt. chest pain (squeezing pain, radiation to back)
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).
• 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).

Raff GL et al. ACC 2006: 807-8

MDCT in Acute chest pain

• "Triple Rule Out"
  - Acute coronary syndrome
  - Aortic dissection
  - Pulmonary embolism

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

MDCT in Acute Chest Pain

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


"Triple Rule Out"

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

“Triple Rule Out”

M441, Acute chest pain
ECG: LBBB, V1~V4 ST elevation, hyperacute T wave, T-wave inversion on Lead II
R/O ST Em, Aortic dissection → R/O Acute pancreatitis

** Intramural Hematoma with Giant Aortic Dissection **
Potential clinical application

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The Merit of CTA for planning of CABG

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

Evaluation of Stent Patency

<table>
<thead>
<tr>
<th>Author</th>
<th>Journal</th>
<th>Assessable</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schuijf JD</td>
<td>Am J Cardiol 2004</td>
<td>70%</td>
<td>78%</td>
<td>100% (patency)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gilard M</td>
<td>Am J Cardiol 2005</td>
<td>75%</td>
<td>96% (restenosis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gilard M</td>
<td>Heart 2006</td>
<td>Left main</td>
<td>100%</td>
<td>100%</td>
<td>92% (restenosis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 3.0 mm</td>
<td>81%</td>
<td>86%</td>
<td>100% (restenosis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 3.0 mm</td>
<td>51%</td>
<td>54%</td>
<td>100% (restenosis)</td>
<td></td>
</tr>
</tbody>
</table>

16-Slice MDCT

Evaluation of Stent Patency

- Left main
- Stent diameter: > 3.0 mm
- Strut thickness: < 140 micro
- Instant restenosis: > 35%
- Stainless steel
Potential clinical application

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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.


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Anomalous Origin of Coronary Artery

Coronary CTA:
Screening test in Asymptomatic patient?

EK Choi et al 2006, AHA

Dec 2005 ~ May 2006
Health check-up
Single Center, Retrospective

Control group
(n=1067)

CCTA group
(n=1067)

Age, sex, ETT matched
with MDCT group

Self reported questionnaire

Coronary CTA: W/U
(n=1074)

ASX

CCTA group
(n=1067)

No MDCT W/U
(n=4591)

Total population
(n=5665)

Exclusion

Self reported questionnaire

Age, sex, ETT matched
with MDCT group

Coronary CTA: W/U
(n=1074)
Risk Stratification according to NCEP guideline

- **High-risk Group**
  - CHD or CHD risk equivalent (10-yr risk > 20%)

- **Moderate-risk Group**
  - ≥ 2 risk factors (10-yr risk < 20%)

- **Low-risk Group**
  - 0-1 risk factors

Risk factors: cigarette smoking, hypertension (BP ≥ 140/90 mmHg or antihypertensive medication), HDL cholesterol < 40 mg/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; age men ≥ 45 years; women ≥ 55 years).

Coronary CTA: Screening test in Asymptomatic patient?

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

  Asymptomatic patient with moderate to high risk (CT-2b):
  - 15/1067 (1.4%) vs. 2/1067 (0.1%)

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

Coronary CTA: New Paradigm?

- Should coronary CTA 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.
Coronary CTA: New Paradigm?

<table>
<thead>
<tr>
<th>Modality</th>
<th>Cost</th>
<th>Time</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMT</td>
<td>36,000원</td>
<td>20 min</td>
<td>50%</td>
</tr>
<tr>
<td>Stress EchoCG</td>
<td>400,000원</td>
<td>30 min</td>
<td>82%</td>
</tr>
<tr>
<td>SPECT</td>
<td>600,000원</td>
<td>4 hour</td>
<td>90%</td>
</tr>
<tr>
<td>MRI</td>
<td>750,000원</td>
<td>1 hour</td>
<td>90%</td>
</tr>
<tr>
<td>PET</td>
<td>700,000원</td>
<td>2 hour</td>
<td>90%</td>
</tr>
<tr>
<td>CT</td>
<td>300,000원</td>
<td>15 min</td>
<td>82%</td>
</tr>
</tbody>
</table>

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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