Influence of Heart Rate on the Accuracy of Dual Source CT for Coronary Stenosis Detection in Patients with Intermediate Likelihood of Disease: Results of the International Multicenter MEDIC Trial

MEDIC Trial sponsored by Siemens and Bayer.
Background

Several multicenter trials have investigated the accuracy of 64-slice CT for the detection of coronary stenoses by blinded comparison to core-lab read coronary angiography (see table). No such data exist for newer scanner generations, such as dual source CT.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCURACY(^1)</td>
<td>230</td>
<td>95%</td>
<td>83%</td>
<td>24%</td>
</tr>
<tr>
<td>Meijboom(^2)</td>
<td>360</td>
<td>99%</td>
<td>64%</td>
<td>68%</td>
</tr>
<tr>
<td>CORE 64(^3)</td>
<td>291</td>
<td>85%</td>
<td>90%</td>
<td>56%</td>
</tr>
</tbody>
</table>

\(^1\) Budoff et al, JACC 2008
\(^2\) Meijboom et al, JACC 2008
\(^3\) Miller et al, NEJM 2008
MEDIC Trial

Multicenter Evaluation of Dual Source CT in Patients with Intermediate Likelihood of Coronary Artery Stenoses (MEDIC)

INCLUSION CRITERIA

- Patients scheduled for coronary angiography due to suspected CAD
- 30-80 years of age
- 30% - 80% pre-test likelihood of coronary stenoses
- Agatston Score < 800
MEDIC Trial

EXCLUSION CRITERIA

- Previous PCI or bypass surgery
- Agatston Score > 800
- Atrial fibrillation or > 6 ectopic beats / minute
- Inability to perform 10 second breathhold
- Renal insufficiency (creatinine > 1.8 mg/dl)
- Medication with metformin that cannot be interrupted after CT
- Inability to establish antecubital i.v. access (18G)
- Unstable clinical condition
- Possible pregnancy
- Inability to provide informed consent
- For sites located in Germany: participation in a scientific study that exposed the patient to radiation within the previous 10 years.

SAMPLE SIZE

90% power to identify a sensitivity > 90% for stenosis detection
=> 393 patients
PROTOCOL

No beta blocker for patient preparation

Dual Source CT

2 x 64 x 0.6 mm collimation -- 0.33 s rotation
2 x 128 x 0.6 mm collimation – 0.28 s rotation

Spiral acquisition with retrospective ECG gating

Tube settings:

<table>
<thead>
<tr>
<th>Weight Range</th>
<th>Tube Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 90 kg and BMI &lt; 30:</td>
<td>100 kV/360 mAs</td>
</tr>
<tr>
<td>90-110 kg:</td>
<td>120 kV/360 mAs</td>
</tr>
</tbody>
</table>

Current modulation:

<table>
<thead>
<tr>
<th>Heart Rate Range</th>
<th>Current Modulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR &gt; 65/min</td>
<td>40-70%</td>
</tr>
<tr>
<td>HR 60-65/min:</td>
<td>70-70%</td>
</tr>
<tr>
<td>HR &lt; 60/min:</td>
<td>70-70%, off in systole</td>
</tr>
</tbody>
</table>

Contrast Agent

Ultravist 370 mg/dl, 6ml/s for 10 seconds
PROTOCOL

CORONARY CT ANGIOGRAPHY

Core lab interpretation of coronary CT angiography

SCCT 18 segment model

All vessels evaluated for the presence of at least one stenosis > 50% luminal diameter reduction

INVASIVE CORONARY ANGIOGRAPHY

Core lab interpretation of invasive coronary angiography

SCCT 18 segment model

Reference diameter

Degree of stenosis in vessels with a reference diameter of 2.0 mm or more
RESULTS

480 patients screened

65 patients excluded

<table>
<thead>
<tr>
<th>Reason</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agatston Score</td>
<td>38</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>19</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
</tr>
</tbody>
</table>

415 patients included

- 60±11 years, 51% male
- 81±24 kg
- Mean peak heart rate during CTA 72±20/min
- DLP 424±237 cm*mGy (5.9 mSv)
RESULTS

Female, 48 y, 73 kg, BMI 28 kg/m²
HR 58/min, DLP 289 (4.0 mSv)
Female, 48 y, 73 kg, BMI 28 kg/m²
HR 58/min, DLP 289 (4.0 mSv)
RESULTS

Female, 48 y, 73 kg, BMI 28 kg/m²
HR 58/min, DLP 289 (4.0 mSv)
RESULTS

Female, 45 y, 70 kg, BMI 28kg/m²
HR 55/min, DLP 424 (5.9 mSv)
Female, 45 y, 70 kg, BMI 28kg/m²
HR 55/min, DLP 424 (5.9 mSv)
FALSE NEGATIVE RESULT IN DISTAL CX

m, 76 y, 76 kg, BMI 27 kg/m²
HR 67/min, DLP 334 (4.6 mSv)
111 patients with at least one coronary artery stenosis > 50%

Disease prevalence 27%

<table>
<thead>
<tr>
<th>&gt; 50% Diameter Stenosis</th>
<th>Per Patient</th>
<th>Per Vessel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>96% (106/111)</td>
<td>85% (153/181)</td>
</tr>
<tr>
<td>Specificity</td>
<td>95% (289/304)</td>
<td>96% (1420/1477)</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>88% (106/121)</td>
<td>73% (153/210)</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>98% (289/294)</td>
<td>98% (1420/1448)</td>
</tr>
</tbody>
</table>

LR+ = 19.1
LR- = 0.04
HIGHER HEART RATE

f, 80 y, 61 kg, BMI 27
HR 70/min, DLP 355 (5.0 mSv)
f, 80 y, 61 kg, BMI 27
HR 70/min, DLP 355 (5.0 mSv)
f, 53 y, 70 kg, BMI 24, HR 73/min, DLP 359 (5.0 mSv)
f, 86 y, 92 kg, BMI 34
HR 77/min, DLP 541 (7.5 mSv)
f, 58 y, 65 kg, BMI 23,
HR 86/min, DLP 652 (9.1 mSv)
HIGHER HEART RATE

f, 58 y, 65 kg, BMI 23, HR 86/min, DLP 652 (9.1 mSv)
## INFLUENCE OF HEART RATE ON ACCURACY

<table>
<thead>
<tr>
<th>Heart Rate</th>
<th>n</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive Predictive Value</th>
<th>Negative Predictive Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>415</td>
<td>96% (106/111)</td>
<td>95% (289/304)</td>
<td>88% (106/121)</td>
<td>98% (289/294)</td>
</tr>
<tr>
<td>≤ 60/min</td>
<td>145</td>
<td>98% (42/43)</td>
<td>95% (97/102)</td>
<td>89% (42/49)</td>
<td>99% (97/98)</td>
</tr>
<tr>
<td>&gt; 60/min</td>
<td>270</td>
<td>94% (64/68)</td>
<td>95% (193/203)</td>
<td>87% (64/74)</td>
<td>98% (193/197)</td>
</tr>
<tr>
<td>&gt; 75/min</td>
<td>92</td>
<td>100% (25/25)</td>
<td>94% (67/71)</td>
<td>86% (25/29)</td>
<td>100% (67/67)</td>
</tr>
</tbody>
</table>
LIMITATIONS

Visual analysis
No correlation to ischemia
No very-low-dose protocol
Prevalence lower than estimated
SUMMARY

First multicenter trial which investigated

- Dual Source CT
- Without beta blockade
- In patients with intermediate pre-test likelihood of coronary artery disease

High sensitivity (96%) and specificity (95%) to identify patients with at least one high-grade coronary artery stenosis.

Accuracy maintained at higher heart rates.