CT Coronary Angiography: Accuracy and Potential Applications

S. Achenbach

Department of Cardiology
University of Erlangen, Germany
MDCT permits high-resolution, non-invasive imaging of the coronary artery lumen
Accuracy of MDCT in comparison to invasive coronary angiography
2000: MDCT 4 slice
2002: First 16-slice MDCT
2002: First 16-slice MDCT

Achenbach: CT Coronary Angiography
2002: First 16-slice MDCT
2004: 64-slice MDCT

Achenbach: CT Coronary Angiography

SCCT Lecture Series
2004: 64-slice MDCT

Achenbach: CT Coronary Angiography

SCCT Lecture Series
### Accuracy for stenosis detection in recent studies of 16- and 64 slice CT

<table>
<thead>
<tr>
<th>Study</th>
<th>Journal Year</th>
<th>n</th>
<th>Sens.</th>
<th>Spec.</th>
<th>not evaluable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mollet</td>
<td>JACC 2005</td>
<td>51</td>
<td>95%</td>
<td>98%</td>
<td>--</td>
</tr>
<tr>
<td>Kuettner</td>
<td>Heart 2005</td>
<td>72</td>
<td>85%</td>
<td>98%</td>
<td>7%</td>
</tr>
<tr>
<td>Hoffmann</td>
<td>JAMA 2005</td>
<td>103</td>
<td>95%</td>
<td>98%</td>
<td>6%</td>
</tr>
<tr>
<td>Achenbach</td>
<td>Eur Heart J 2005</td>
<td>50</td>
<td>93%</td>
<td>95%</td>
<td>5%</td>
</tr>
<tr>
<td>Morgan-Hughes</td>
<td>Heart 2005</td>
<td>57</td>
<td>89%*</td>
<td>98%</td>
<td>-</td>
</tr>
<tr>
<td>Leschka</td>
<td>Eur Heart J 2005</td>
<td>57</td>
<td>94%</td>
<td>97%</td>
<td>--</td>
</tr>
<tr>
<td>Raff</td>
<td>JACC 2005</td>
<td>70</td>
<td>86%</td>
<td>95%</td>
<td>12%</td>
</tr>
<tr>
<td>Leber</td>
<td>JACC 2005</td>
<td>59</td>
<td>87%**</td>
<td>98%</td>
<td>--</td>
</tr>
<tr>
<td>Ropers</td>
<td>AJC 2006</td>
<td>82</td>
<td>95%</td>
<td>93%</td>
<td>4%</td>
</tr>
<tr>
<td>Mollet</td>
<td>Circulation 2005</td>
<td>52</td>
<td>99%</td>
<td>95%</td>
<td>2%</td>
</tr>
</tbody>
</table>

* Calcium Score < 400, ** Calcium Score < 1000
Accuracy for stenosis detection in recent studies of 16-and 64 slice CT

Uniformly:
High negative predictive value:

NPV 96-99%
in all studies
If MDCT of the coronary arteries is carefully performed, it permits to rule out the presence of coronary artery stenoses with a high negative predictive value.

Image quality and diagnostic accuracy are better for lower heart rates and in patients without pronounced calcification.

Hoffmann, JAMA 2005
Kuettner, JACC 2004
Hofmann, Circulation 2004
Leber, JACC 2005
Limitations of MDCT for Coronary Angiography:

Severe calcifications and artifacts caused by motion can impair evaluability.
Limitations of MDCT for Coronary Angiography:

MDCT requires contrast agent, exposure to x-ray, as well as a regular and, preferrably, low heart rate. It can therefore not be applied in all patients.

Importantly, MDCT is a purely diagnostic tool. In patients with a high pre-test likelihood of disease, the use of MDCT will thus often not be advantageous since the presence of at least one stenosis can be expected and invasive angiography, with the option of immediate intervention, will constitute are more useful diagnostic (and possibly therapeutic) tool.
Potential Applications for Coronary Angiography:

Based on the current scientific studies, the MDCT with 16- or 64-slice CT may be clinically useful to rule out the presence of coronary stenoses in patients who have clinically suspected coronary artery disease with the need for further work-up, but a low to intermediate pre-test likelihood of disease.
### TABLE 2. Pretest Likelihood of CAD in Symptomatic Patients According to Age and Sex*

<table>
<thead>
<tr>
<th>Age, y</th>
<th>Nonanginal Chest Pain</th>
<th>Atypical Angina</th>
<th>Typical Angina</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>30–39</td>
<td>4</td>
<td>2</td>
<td>34</td>
</tr>
<tr>
<td>40–49</td>
<td>13</td>
<td>3</td>
<td>51</td>
</tr>
<tr>
<td>50–59</td>
<td>20</td>
<td>7</td>
<td>65</td>
</tr>
<tr>
<td>60–69</td>
<td>27</td>
<td>14</td>
<td>72</td>
</tr>
</tbody>
</table>

* AHA/ACC Consensus Statement CAD, Circulation 2002
56-year old female patient with atypical chest pain and an abnormal stress ECG, suggestive of inferior ischemia.
56-year old female patient with atypical chest pain and an abnormal stress ECG, suggestive of inferior ischemia

Left main and left anterior descending coronary artery
56-year old female patient with atypical chest pain and an abnormal stress ECG, suggestive of inferior ischemia.

Left main and left circumflex coronary artery.
56-year old female patient with atypical chest pain and an abnormal stress ECG, suggestive of inferior ischemia.

Right coronary artery
An anomalous left circumflex (LCX) artery originating from the right coronary ostium can be accurately identified and analyzed using MDCT (multi-detector row computed tomography). This technique offers a non-invasive alternative for visualizing and assessing coronary artery anatomy, as evidenced by the studies of Ropers et al. (Am J Cardiol 2001), Deibler et al. (Mayo Clin Proc 2004), Datta et al. (Radiology 2005), and Schmid et al. (Int J Cardiol 2005).
Imaging of bypass grafts and stents will be addressed in separate presentations
MDCT, performed with state-of-the-art equipment and under the prerequisite of very good image quality, has a high negative predictive value to rule out the presence of significant coronary artery stenoses.

It is thus potentially useful to exclude coronary artery disease in patients who do not have a high pre-test likelihood of disease.