The relationship between coronary artery stenosis using non-invasive computed tomography coronary angiography and invasive fractional flow reserve in patients with ischemic heart disease

Poster No.: C-0615  
Congress: ECR 2016  
Type: Scientific Exhibit  
Keywords: Cardiac, Cardiovascular system, CT-Angiography, CAD, Diagnostic procedure, Ischaemia / Infarction  
DOI: 10.1594/ecr2016/C-0615

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Aims and objectives

- Multislice computed tomography coronary angiography (CTA) can has good diagnostic accuracy in the assessment of coronary artery stenosis [1, 2]. Therefore, CTA is widely used to diagnose coronary artery disease (CAD) as a screening test. However, the anatomical significance of a coronary artery stenosis does not always equate with functional significance.
- According to the guidelines (European Society of Cardiology, / American Heart Association, the decision to perform percutaneous coronary intervention (PCI) should integrate anatomical information with a test that provides objective proof of ischemia [3]. The pressure-derived myocardial fractional flow reserve (FFR) indicates the functional severity of coronary artery stenosis and FFR is the gold standard for the assessment of coronary lesion-related ischemia [4].
- In the present study, we investigated the relationship between the coronary artery stenosis by computed tomography coronary angiography (CTA) and FFR measurement.
Methods and materials

Study Population

- A retrospective analysis was performed in patients with suspected CAD who underwent clinically indicated coronary angiography (CTA), CAG and measurement FFR between December 2007 and July 2010. The decision to measure FFR was based entirely on the appearance of a coronary intermediately narrowing on CAG and the measurement was performed at the interventional cardiologist's discretion. All patients were scanned by either SOMATOM Definition (SIEMENS, Germany; period from December 2007 to September 2009) or SOMATOM Definition Flash (SIEMENS, Germany; period from September 2009 to July 2010).
- CAG was performed within 3 months after CTA
- Total 35 lesions in 27 patients were included in this study
- Exclusion criteria for CTA
  1) Renal insufficiency (Ccr<40 ml/min/m²)
  2) Acute myocardial infarction
  3) Known allergy to iodine contrast media

CTA protocol

- ß-blocker was not administered prior to scan.
- Contrast material was Iopamidol 370.
- Twenty two patients were scanned with SOMATOM Definition scanner. Angiographic scan parameters were: 32×2×0.6mm collimation with z-flying focal spot. Scan timing was set using bolus tracking.
- Five patients were scanned with SOMATOM Definition Flash scanner. Angiographic scan parameters were: 64×2×0.6mm collimation with z-flying focal spot. Scan timing was set using test injection.

Measured anatomic characteristics in CTA

- Two radiologists without knowing CAG and FFR results independently analyzed the coronary arteries using an office workstation (Leonardo, SIEMENS, Germany). Initially, the specific lesion was evaluated with axial
slices to analyze coronary stenosis, and curved multiplanar reformatted reconstructions were additionally used if necessary.

- Each lesion was graded as having diameter stenosis of either $\geq 75\%$ or $<75\%$ luminal narrowing.
- Significant stenosis was defined as narrowing of the coronary luminal diameter $>75\%$.
- Exclusion criteria for data analysis
  1) Diameter $\leq 1.5$ mm
  2) Severe calcification
  3) Motion artifact image

**FFR measurement**

- Pressure Wire
  CERTUS (ST. JUDE MEDICAL, USA)

  FFR measurement was performed in the distal and very proximal target lesion of coronary artery during maximal hyperemia obtained by intra coronary injection of a bolus of papaverine hydrochloride.
- A coronary stenosis with an FFR value $\leq 0.75$ was considered as functional significance.
Results

- Patients' characteristics are shown in Table 1 on page 6.
- During coronary angiography, FFR measurements were obtained in the left anterior descending coronary artery (n=18), the right coronary artery (n=8), the left circumflex coronary artery (n=7) and the left main trunk (n=2), resulting in 35 vessels for analysis.
- Patients' management is shown in Table 2 on page 6.
- Fig. 1 on page 7 shows the representative example of the intermediate coronary stenosis without functional significance evaluated by FFR measurement (FFR=0.89). Fig. 2 on page 8 shows the example of the intermediate stenosis with functional significance by FFR measurement (FFR=0.65).
- Fig. 3 on page 9 shows non-significant coronary stenosis and Fig. 4 on page 10 shows significant coronary stenosis in CTA.
- In total 35 lesions (27 patients) of CTA, 20 lesions (57%) were graded as non-significant stenosis and 15 lesions (43%) were graded as significant stenosis. The values of FFR of the non-significant stenosis and significant stenosis were 0.86±0.58 and 0.78±0.90, respectively (Mean±SD, Student t-test, p<0.05). All of the values of FFR in the patients with non-significant stenosis in CTA were over 0.75. Further details are provided in Fig. 5 on page 11.
- The indication of PCI with FFR measurement was only within the patients with significant stenosis in CTA (Fig. 5 on page 11).
**Patients’ Characteristics (n=27)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>63±14</td>
</tr>
<tr>
<td>Old myocardial infarction</td>
<td>13</td>
</tr>
<tr>
<td>Diabetes</td>
<td>11</td>
</tr>
<tr>
<td>Hypertension</td>
<td>20</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>17</td>
</tr>
<tr>
<td>Smoker</td>
<td>16</td>
</tr>
<tr>
<td>Family history</td>
<td>12</td>
</tr>
<tr>
<td>BMI ≥ 30 kg/m²</td>
<td>3</td>
</tr>
<tr>
<td>Heart rate (beats/min)</td>
<td>68±15</td>
</tr>
<tr>
<td>Gender, male/female</td>
<td>26/1</td>
</tr>
</tbody>
</table>

Mean±SD or number

**Table 1**: Patients' Characteristics

© The Jikei University School of Medicine - Tokyo/JP
Table 2: Patients’ Management

<table>
<thead>
<tr>
<th>Therapeutic decision</th>
<th>Lesions number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical therapy</td>
<td>29</td>
</tr>
<tr>
<td>PCI</td>
<td>6</td>
</tr>
<tr>
<td>Coronary artery bypass graft</td>
<td>0</td>
</tr>
</tbody>
</table>

© The Jikei University School of Medicine - Tokyo/JP
Fig. 1: CAG and FFR measurement of intermediate coronary lesion without functional significance. Coronary artery stenosis in the right coronary artery is shown (A). The FFR of the lesion indicated by an arrow was 0.89 (B).

© The Jikei University School of Medicine - Tokyo/JP
Fig. 2: CAG and FFR measurement of intermediate coronary lesion with functional significance. Coronary artery stenosis in the left circumflex artery is shown (A). The FFR of the lesion indicated by an arrow was 0.65 (B).

© The Jikei University School of Medicine - Tokyo/JP
Fig. 3: Non-significant coronary stenosis in CTA. Non-significant coronary stenosis in the left circumflex artery as visualized with CTA is shown (arrow). A shows curved multiplanar reformatted reconstructions and B shows stretched multiplanar reconstructions.

© The Jikei University School of Medicine - Tokyo/JP
Fig. 4: Significant coronary stenosis in CTA. Significant coronary stenosis in the right coronary artery as visualized with CTA is shown (arrow). A shows curved multiplanar reformatted reconstructions and B shows stretched multiplanar reconstructions.

© The Jikei University School of Medicine - Tokyo/JP
**Fig. 5:** Relationship between the coronary stenosis estimated by CTA and FFR measurement. FFR values were divided into 2 groups according to the coronary stenosis estimated by CTA (non-significant: <75% and significant: ≥75%). Diamond symbols show FFR values in each coronary lesion. Closed diamonds show the indication of PCI.

© The Jikei University School of Medicine - Tokyo/JP
Conclusion

• The anatomical assessment of the significance of coronary stenosis determined by CTA was well correlated with functional assessment of FFR.
• Non-significant stenosis defined with CTA can eliminate the indication of PCI without the invasive measurement of FFR.

Limitation

• The number of subjects was small. Future studies with larger number of patients are needed to confirm our findings.
• We usually measured FFR of the intermediate coronary lesions onsite during the CAG. Therefore we did not enroll patients who have normal coronary or severe stenosis lesions.
• Lesions with severe calcification and small diameter vessels were excluded in this study.
Personal information

Ikuko Anan, M.D., Ph.D.

Division of Cardiology
Department of Internal Medicine
The Jikei University School of Medicine
Tokyo, Japan

ms97-anan@jikei.ac.jp
References


