Invasive coronary diagnostics: research tools or clinically relevant?

William Wijns, MD, PhD
Cardiovascular Center, Aalst, B

Davos, 14 February 2013
Invasive coronary diagnostics: research tools or clinically relevant?

FFR
IVUS
OCT

Clinically relevant = with demonstrated impact on clinical outcome (hard events, by evidence-based standards)
Outcome based validation studies for FFR

1. **Intermediate stenoses**
   - Bech, Circulation 2001
   - Pijls, JACC 2010

2. **Post-myocardial setting**
   - De Bruyne, Circulation 2001
   - Ntalianis, JACCInterv 2010

3. **Multivessel disease**
   - Berger, JACC 2005
   - Botman, CCI 2004
   - De Bruyne, The Lancet 2012

4. **Left main stenosis**
   - Hamilos, Circulation 2009

5. **Proximal LAD stenosis**
   - Muller, JACCInterv 2011

6. **Bifurcation lesions**
   - Koo, Eur Heart J 2010

7. **Hybrid Revascularization**
   - Davidavicius, Circulation 2005

8. **Post CABG**
   - Botman, Ann Thor Surg 2007
FFR is disruptive by HTA standards (FAME trial)
Invasive coronary diagnostics: research tools or clinically relevant?

FFR I A

IVUS IIb C (left main)

OCT

Clinically relevant = with demonstrated impact on clinical outcome (hard events, by evidence-based standards)
Why did IVUS fail to become a clinically useful tool?

• Used as an add-on technology, when only disruptive new invasive diagnostic tools eventually succeed

• Studies were shooting for the wrong endpoint, restenosis reduction, without offering a solution to this non naturally occurring disease

• IVUS studies are typically poor, small sized, observational, “cheap”

• Images are difficult to read & interpret (expert reading required)

• No robust link between IVUS information and practice nor outcome

• High cost, low return
Should the value of IVUS be upgraded?

New meta-analysis favors IVUS-guidance over angiography-guidance for PCI with DES

<table>
<thead>
<tr>
<th>Event</th>
<th>Hazard ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>0.59</td>
<td>0.48 - 0.73</td>
</tr>
<tr>
<td>Stent thrombosis</td>
<td>0.58</td>
<td>0.44 - 0.77</td>
</tr>
<tr>
<td>MACE</td>
<td>0.87</td>
<td>0.78 - 0.96</td>
</tr>
</tbody>
</table>

11 studies (10 observational, 1 randomised trial of 210 patients)
19.517 patients (8.102 IVUS guidance, 11.517 angiography)
Baseline differences for relevant variables (age, gender, CKD, …)
Variable event definitions and follow-up duration (12-48 months)

Zgang et al EuroIntervention 2012;8.855-65
<table>
<thead>
<tr>
<th>Test</th>
<th>Clinical Relevance</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFR</td>
<td>++</td>
<td>I A</td>
</tr>
<tr>
<td>IVUS</td>
<td>no, with exceptions</td>
<td>IIb C</td>
</tr>
<tr>
<td>OCT</td>
<td>still to be determined</td>
<td>?</td>
</tr>
</tbody>
</table>
Intracoronary Optical Coherence Tomography: A Comprehensive Review

Clinical and Research Applications

Hiran G. Bezerra, MD, PhD,* Marco A. Costa, MD, PhD,* Giulio Guagliumi, MD,†
Andrew M. Rollins, PhD,† Daniel I. Simon, MD*

Cleveland, Ohio; and Bergamo, Italy
Will OCT become another IVUS: a great research tool with limited clinical relevance?

- OCT imaging provides high resolution information regarding coronary anatomy and the effects of mechanical and pharmacological therapies.

- Are abnormal OCT findings:
  - Unique?
  - Frequent?
  - Potentially relevant?
# CLI-OPCI Study: OCT findings

<table>
<thead>
<tr>
<th>Number of vessels assessed with OCT</th>
<th>Angiographic plus optical coherence tomography guidance group (N=335)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>79.4 %</td>
</tr>
<tr>
<td>2</td>
<td>19.4 %</td>
</tr>
<tr>
<td>3</td>
<td>1.2 %</td>
</tr>
<tr>
<td>OCT on left anterior descending</td>
<td>50.7 %</td>
</tr>
<tr>
<td>OCT pullbacks</td>
<td>3.8 ±1.7</td>
</tr>
</tbody>
</table>

## OCT findings

<table>
<thead>
<tr>
<th>OCT findings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge dissection</td>
<td>14.2 %</td>
</tr>
<tr>
<td>Lumen narrowing</td>
<td>2.8 %</td>
</tr>
<tr>
<td>Stent malapposition</td>
<td>29.7 %</td>
</tr>
<tr>
<td>Stent underexpansion</td>
<td>11.4 %</td>
</tr>
<tr>
<td>Thrombus</td>
<td>22.0 %</td>
</tr>
</tbody>
</table>

## Further intervention after OCT

| Further intervention after OCT      | 34.7 %                         |
CLI-OPCI Study

- Angiography alone versus angiography + OCT to guide decision-making during PCI: impact on 1 year outcome
- A total of 670 patients were included: 335 in the OCT group and 335 in the angiography group (matched from database)

<table>
<thead>
<tr>
<th>N events at 1 y (%)</th>
<th>Angio guidance</th>
<th>Angio + OCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>23 (6.9)</td>
<td>11 (3.3)</td>
</tr>
<tr>
<td>Cardiac death</td>
<td>15 (4.5)</td>
<td>4 (1.2)</td>
</tr>
<tr>
<td>Cardiac death or MI</td>
<td>43 (13.0)</td>
<td>22 (6.6)</td>
</tr>
</tbody>
</table>

Prati et al EuroIntervention 2012;8:823-9
Will OCT become another IVUS: a great research tool with limited clinical relevance?

- OCT imaging provides high resolution information regarding coronary anatomy and the effects of mechanical and pharmacological therapies with suggested clinical impact.
- FFR identifies appropriate targets with improved outcomes and cost savings.
- HYPOTHESIS: Use of FFR and OCT in synergy during PCI will lead to optimised care of CAD pts.
<table>
<thead>
<tr>
<th><strong>Title</strong></th>
<th>Observational Study of OCT in Patients Undergoing FFR and PCI: Stage I</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>To define and evaluate OCT stent guidance parameters through the prospective data collection of PCI procedures of de novo lesions</td>
</tr>
<tr>
<td><strong>Primary Objective</strong></td>
<td>To identify OCT peri-procedural guidance parameters for stent implantation that relate with patient outcomes in the hospital, at 30 days, and 12 months</td>
</tr>
</tbody>
</table>
| **Secondary Objectives** | 1. Assessment of OCT impact on physician decision-making post PCI  
2. Correlation / relationship of OCT parameters, as defined by OCT volumetric analysis, on pre- and post-intervention FFR values  
3. Assess health economic and resource utilization impact |
| **Design**      | Multi-center, prospective, global observational evaluation  
• Approximately 40 centers (EU, Asia, US)  
• Up to 500 subjects (max 50 subjects per site) |
| **Follow-up**   | Hospitalization / Discharge, 30 days, 6 months, 12 months  
• In geographies where longitudinal OCT imaging is routinely performed, the data from that visit will also be collected. |
ILUMIEN TRIAL PROGRAMME (world wide)

Stage 1 Observational: 2012
To determine acute, OCT guidance parameters through a prospective, multi-center study

Stage 2 RCT: 2014
To test findings from stage 1 through a randomized, clinical trial, both acutely and at 12 month follow-up
Exact localisation of the site where FFR jumps
Spiraloid dissection

*Medis QAngioOCT prototype [Tu, et. al., In-vivo Comparison of Arterial Lumen Dimensions Assessed by Co-registered Three-dimensional (3D) Quantitative Coronary Angiography, Intravascular Ultrasound and Optical Coherence Tomography. Int J Cardiovasc Imaging 2012]
Co-registration prior to bioerodible scaffold implant
Take-Home Message

• OCT, a superior invasive imaging tool, is being tested for clinical relevance

• We hypothesize that PCI outcome in complex lesions and high-risk patients can be further optimised with integrated FFR and OCT (the former pays for the latter)

• Adoption of novel invasive imaging will likely be highly variable depending on local health care systems and regulatory environments
Potential conflicts of interest

Speaker’s name: William Wijns, Cardiovascular Center Aalst, B

☐ I have the following potential conflicts of interest to report:

☐ Institutional research contracts with several device and pharmaceutical companies including St Jude Medical

☐ Cardiovascular Center Aalst founded Cardio³Biosciences

☐ Other(s): Chairman of (Euro)PCR