Evolution In Interventional Cardiology

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- Coronary Atherosclerosis
- Timeline in interventional cardiology
- Indications for PCI – Current Guidelines
- PCI in JBZ
Coronary atherosclerosis – Pathology

**Initial lesion**
- histologically "normal"
- macrophage infiltration
- isolated foam cells

**Fatty streak**
- mainly intracellular lipid accumulation

**Intermediate lesion**
- intracellular lipid accumulation
- small extracellular lipid pools

**Atheroma**
- intracellular lipid accumulation
- core of extracellular lipid

**Fibroatheroma**
- single or multiple lipid cores
- fibrotic/calcific layers

**Complicated lesion**
- surface defect
- hematoma-hemorrhage
- thrombosis

**Endothelial Dysfunction**

**Sequences in Progression of Atherosclerosis**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Earliest Onset</th>
<th>Main Growth Mechanism</th>
<th>Clinical Collateration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial lesion</td>
<td>from first decade</td>
<td>growth mainly by lipid addition</td>
<td>clinically silent</td>
</tr>
<tr>
<td>Fatty streak</td>
<td>from third decade</td>
<td>growth mainly by lipid addition</td>
<td>clinically silent</td>
</tr>
<tr>
<td>Intermediate lesion</td>
<td>from third decade</td>
<td>increased smooth muscle and collagen increase</td>
<td>clinically silent or overt</td>
</tr>
<tr>
<td>Atheroma</td>
<td>from fourth decade</td>
<td>increased smooth muscle and collagen increase</td>
<td>clinically silent or overt</td>
</tr>
<tr>
<td>Fibroatheroma</td>
<td>from fourth decade</td>
<td>increased smooth muscle and collagen increase</td>
<td>clinically silent or overt</td>
</tr>
<tr>
<td>Complicated lesion</td>
<td>from fourth decade</td>
<td>thrombosis and/or hematoma</td>
<td>clinically silent or overt</td>
</tr>
</tbody>
</table>
Coronary atherosclerosis – magnitude of the problem

- Atherosclerotic cardiovascular disease is responsible for a third of all deaths in the western world.

- Yearly 60000 men and 30000 women are admitted to hospital in the Netherlands with the main diagnosis of coronary heart disease.
Timeline in Interventional Cardiology - The Last Century

- **1964** — Transluminal Angioplasty, the concept of remodeling the artery, was introduced by Dr. Charles T. Dotter.

- **1977** — First human coronary balloon angioplasty performed intraoperatively by Gruentzig.

- **1977** — Andreas Gruentzig performed first PTCA on awake patient in cath lab in Zurich.
Problems with PTCA (Balloon Dilatation)

- High incidence of restenosis – up to 50% within 1 year
  - Vessel recoil

- Balloon induced endothelial injury
  - High complication rate
Timeline in Interventional Cardiology - The Last Century

- **1986** — First coronary Wallstents were implanted in Toulouse, France

- **1987-1993** — a large number of new interventional devices were invented and perfected:
  - Laser techniques
  - Rotational atherectomy devices (Rotablator),
  - Intravascular ultrasound (IVUS)
  - Stents

- **1994** — the Palmaz-Schatz stent was approved by the F.D.A. for use in the United States

- **1994-1997** — Stents became commonplace and eliminate many complications

- **1997** — Over one million angioplasties performed worldwide, making angioplasty the most common medical intervention in the world
Main Problem with Bare Metal Stents (BMS)

- Relative High incidence of in-stent restenosis. 10-15% in the first year.
  - Neointimal hyperplasia.
Timeline in Interventional Cardiology - This Century

- **2002** — The first human Trials of drug (Sirolimus) eluting stents, Thorax Centre, Rotterdam.

- **2002** — the first drug-eluting stent, Sirolimus Eluting Stent (SES), is approved to be used in Europe marking a major advance in the battle to reduce restenosis to single digits.
Main Problems with Drug Eluting Stents

- Need for long-term (1 year) dual anti-platelet therapy
- A small but important incidence of (late) stent thrombosis
The new generation of drug eluting stents.

- New drugs
- New stent designs
- New drug delivery systems
  - Abluminal coating
  - Biodegradable polymer
- New stent concepts: Bioabsorbable stents /scaffolding

Drug Eluting Balloons
Timeline in Interventional Cardiology - Now & Future

- New non invasive Imaging modalities to aid the interventionalist:
  - CTA: Assessment of lesion characteristics, CTO
  - MRI: Myocardial viability test
  - SPECT-CT: Physiological and morphological information in one test
Timeline in Interventional Cardiology - Now & Future

- Percutaneous Valve implantations
- Percutaneous valve repairs
- ....
PCI and TAVI
Indications For PCI

- Stable coronary disease

- Acute Coronary Syndromes
  - Unstable Angina
  - NSTEMI
  - STEMI
PCI in stable coronary disease ESC guidelines

- Compared with Medical Therapy:
  - PCI, in general, does not provide survival benefit in stable angina
  - PCI is more effective at reducing events that impair quality of life

- PCI may be considered as an effective option for the treatment of symptoms.

- Single or multivessel PCI can be performed with high likelihood of success using stents and adjuvant therapy
  - Risk of death is 0.3-1%
**Indications for revascularisation in stable angina or silent ischaemia**

<table>
<thead>
<tr>
<th>Subset of CAD by anatomy</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left main &gt;50%⁴</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Any proximal LAD &gt;50%⁴</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>2VD or 3VD with impaired LV function⁴</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Proven large area of ischaemia (&gt;10% LV)</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Single remaining patent vessel &gt;50% stenosis⁴</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>IVD without proximal LAD and without &gt;10% ischaemia</td>
<td>III</td>
<td>A</td>
</tr>
</tbody>
</table>

**For symptoms**

<table>
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<tr>
<th>Subset of CAD by anatomy</th>
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<tr>
<td>Any stenosis &gt;50% with limiting angina or angina equivalent, unresponsive to OMT</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Dyspnoea/CHF and &gt;10% LV ischaemia/viability supplied by &gt;50% stenotic artery</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>No limiting symptoms with OMT</td>
<td>III</td>
<td>C</td>
</tr>
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</table>
Revascularisation in stable coronary disease - Situations where CABG is favourable to PCI

| 3VD complex lesions, incomplete revascularization achievable with PCI, SYNTAX score >22 | I A | III A |
| Left main + 2VD or 3VD, SYNTAX score ≥33 | I A | III B |
**Recommendations for revascularisation in non-ST-segment elevation acute coronary syndrome**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Class&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>An invasive strategy is indicated in patients with:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• GRACE score &gt;140 or at least one high-risk criterion.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>• recurrent symptoms.</td>
<td></td>
<td></td>
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<tr>
<td>• inducible ischaemia at stress test.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>An early invasive strategy (&lt;24 h) is indicated in patients with GRACE score</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>score &gt;140 or multiple other high-risk criteria.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A late invasive strategy (within 72 h) is indicated in patients with GRACE</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>score &lt;140 or absence of multiple other high-risk criteria but with recurrent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>symptoms or stress-inducible ischaemia.</td>
<td></td>
<td></td>
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<tr>
<th>Specification</th>
<th>Class&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
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<tr>
<td>Patients at very high ischaemic risk (refractory angina, with associated</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>heart failure, arrhythmias or haemodynamic instability) should be</td>
<td></td>
<td></td>
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<tr>
<td>considered for emergent coronary angiography (&lt;2 h).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>An invasive strategy should not be performed in patients:</td>
<td>III</td>
<td>A</td>
</tr>
<tr>
<td>• at low overall risk.</td>
<td></td>
<td></td>
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<tr>
<td>• at a particular high-risk for invasive diagnosis or intervention.</td>
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<td></td>
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### Recommendations for Emergency PCI in ST Elevation Myocardial Infarction (STEMI) Patients

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
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<tr>
<td>Implementation of a well-functioning network based on pre-hospital diagnosis, and fast transport to the closest available primary PCI-capable centre is recommended.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Primary PCI-capable centres should deliver 24 h per day/7 days per week on-call service, be able to start primary PCI as soon as possible and within 60 min from the initial call.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>In PCI-capable centres, unnecessary intermediate admissions to the emergency room or the intensive care unit should be avoided.</td>
<td>III</td>
<td>A</td>
</tr>
<tr>
<td>The systematic use of balloon counterpulsation, in the absence of haemodynamic impairment, is not recommended.</td>
<td>III</td>
<td>B</td>
</tr>
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PCI in JBZ

- PCI In ‘s-Hertogenbosch since October 2008
- Two state of the art catheterisation labs
- Fully trained and motivated personnel
- Three interventional cardiologists
- Since 1\textsuperscript{st} September 2010 round the clock PCI services
PCI in JBZ

- Over 700 procedures so far in 2010
- Established and efficient working system with department of cardiothoracic surgery in UMC Utrecht.
- Growing co-operation with regional hospitals.
Future of PCI in JBZ

- 4th interventional cardiologist April/May 2011
- Planned relocation to new hospital in April 2011
  - Better regional accessibility
  - Direct access to emergency cardiac room / cath lab for ACS patients
- Aim to perform annually over 1000 procedures
RCA pre PCI
Pre-dilatation
Balloon result
Stent implantation
In Conclusion

- Interventional cardiology has come far……But there is much, much further to go.

- Interventional cardiology is a rapidly expanding and a very dynamic field.

- Patients benefit most when interventionalist and cardiothoracic surgeon work as a team.

- And…
Evolution inevitably leads to improvement…
Evolution inevitably leads to improvement…

Or does it?

Somewhere, something went terribly wrong