I have nothing to disclose.
The grey zone of coronary interventions:
The "real" bifurcation

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Bifurcation PCI

- Account for 15-20% of PCI
- Why an individualized approach?
  - Variations in Anatomy
    - Left main bifurcation disease
    - Plaque burden & location of plaque
    - Angle between MB and SB
  - Dynamic changes in anatomy during treatment
    - Plaque shift
    - Dissection

No two bifurcations are identical
Bifurcation PCI: What Are The Main Objectives?

Restore the natural configuration (fractal) of the bifurcation:

• Optimal rheology;
• Stent well apposed;
• Easy access to SB in the future;
Murray’s law

\[ 3.68 = 0.67 \times (3.0 + 2.5) \]

Finet’s law

\[ D_1 = 0.678 \times (D_2 + D_3) \]

\[ D_1^3 = D_2^3 + D_3^3 \]

(Murray’s law)

D_

mother = 0.67 \times (D_{\text{daughter 1}} + D_{\text{daughter 2}})

Insights from the 2\textsuperscript{nd} meeting of the EBC. EuroIntervention 2007;3:44
Atheroma and the Carina

1. Slow flow;
2. Low and oscillatory shear stress.

3D Bifurcation Angle

Pre PCI

Post PCI

![Diagram showing bifurcation angles before and after PCI procedure.](image)

**Bifurcation Data**

- Bif Prox Angle: 124 °
- Bif Dist Angle: 83 °

- Bif Prox Angle: 131 °
- Bif Dist Angle: 72 °

**Cardiop-B application by Paieon Inc, Israel**

Girasis et al. J Am Coll Cardiol 2010
LAD
DIAGONAL (D1)
VIEW PERPENDICULAR TO VESSEL WALL
CARINA
LAD
CARINA
D1
D1
D1
PRE
Optimal Approach to Bifurcation PCI?
European Bifurcation Club 2005

• Idea Formulated 2004
• Originated from Bordeaux/ICPS
• Based on success of Japanese CTO club
• A “think-tank” of cardiologists with a particular interest in bifurcations
• A non-political, independent and informal club, promoting open discussion, exchange of ideas and development of collaborative research
• A place to make friends..............

David Hildick-Smith, EBC ROME 2006
Consensus so far...

Percutaneous coronary intervention for bifurcation disease.
A consensus view from the first meeting of the European Bifurcation Club

Percutaneous coronary intervention for bifurcation lesions: 2008 consensus document from the fourth meeting of the European Bifurcation Club

Consensus from the 5th European Bifurcation Club meeting
the MEDINA classification should be used for bifurcation lesions (1,0) and MADS classification for bifurcation stenting techniques (MADS: Main, Across, Distal, Side, based on the manner in which the first stent has been implanted);
## Randomized Bifurcation Trials Comparing One vs. Two-Stent Strategy

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients (N)</th>
<th>Randomization</th>
<th>Primary End Point</th>
<th>Outcome (Provisional vs Systematic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORDIC</td>
<td>413</td>
<td>Provisional vs systematic (crush, culotte, T)</td>
<td>Death, MI (nonproced), TVR, or stent thrombosis at 6 mo</td>
<td>2.9% vs 3.4% (P=NS)</td>
</tr>
<tr>
<td>CACTUS</td>
<td>350</td>
<td>Provisional vs systematic (crush)</td>
<td>Death, MI, TVR at 6 mo</td>
<td>15% vs 15.8% (P=NS)</td>
</tr>
<tr>
<td>BBC ONE</td>
<td>500</td>
<td>Provisional vs systematic (crush, culotte)</td>
<td>Death, MI, TVF at 9 mo</td>
<td>8.0% vs 15.2% (P&lt;0.05)</td>
</tr>
<tr>
<td>BBK</td>
<td>202</td>
<td>Provisional vs systematic (T)</td>
<td>Death, MI, TVF at 9 mo; Angiographic restenosis (SB) 9 mo</td>
<td>23.0% vs 27.7% (P=NS)</td>
</tr>
<tr>
<td>Colombo et al.</td>
<td>85</td>
<td>Provisional vs systematic (crush, T, culotte)</td>
<td>Angiographic restenosis (either branch) 6 mo</td>
<td>18.7% vs 28.0% (P=NS)</td>
</tr>
<tr>
<td>Pan et al.</td>
<td>91</td>
<td>Provisional vs systematic (T)</td>
<td>Angiographic restenosis (either branch) 6 mo</td>
<td>7% vs 25% (P=NS)</td>
</tr>
<tr>
<td>DK-CRUSH 2</td>
<td>370</td>
<td>Provisional vs systematic (Double-kissing DK-crush)</td>
<td>Death, MI, TVR at 12 mo</td>
<td>17.3% vs 10.3% (P=NS)</td>
</tr>
</tbody>
</table>
One Stent is Better

- Routine complex (two vessel) stenting does not improve either angiographic or clinical outcomes for most patients with coronary bifurcation lesions.
- Therefore, one main vessel (MV) stenting strategy with provisional Side Branch (SB) stent is the reference technique for most patients with coronary bifurcation lesions.

Consensus from 5th EBC meeting. EuroIntervention 2010;6(1):34-8
Provisional SB stenting Technique
Implications of Murray's law

Recommendations:

- In single stent techniques, the primary stent should be sized according to the **distal main vessel diameter**.
- Postdilatation (POT), or kissing balloon inflations (FKB), are required to optimise the proximal main vessel stent diameter.

D1 = 0.67 * (D2 + D3)

Stankovic et al. Insights from the 4th meeting of the EBC. EuroIntervention 2009;5:39-49
Proximal Optimisation Technique (POT)

Optimal Provisional SB Stenting

D1 = 0.67 * (D2 + D3)

- Expansion of the stent at the carina, using a short oversized balloon
- Produces curved expansion of the stent into the bifurcation point and facilitates recrossing, distal recrossing, kissing inflations and ostial stent coverage of the side branch

First Recommendation: the POT technique should be used in any case of difficulty recrossing into a side branch

Consensus from 5th EBC meeting. EuroIntervention 2010;6(1):34-8
Value of kissing inflations in simple stenting

NORDIC III

Primary end point
MACE (cardiac death, index lesion MI, TLR, stent thrombosis) after 6 months

- Conclusion: Routine use of Final Kissing Balloon (FKB) did not improve clinical outcome, but there was not a penalty for undertaking FKB

Provisional SB stenting Technique

Case History

- 62 years old
- Female patient
- No risk factors
- ACS, troponin +
✓ L. fem. Approach
✓ EBU 7F
✓ Venture® Monorail
✓ Whisper LS
- Sprinter 3.0x15 16 ATM
- 2 Runthrough
- Whisper LS
Nobori 3.5x18mm
After stenting
✓ After stenting
✓ Gazella 3.0x23 16 ATM
After stent deployment
After POT

✓ Durastar 4.0x10, 16 Atm
Kissing balloon

- Durastar 3.5x10, 14 Atm
- Durastar 3.0x10, 16 Atm
- Maverick 2.5x20, 12 Atm
After Kissing balloon

- Durastar 3.5x10, 14 Atm
- Durastar 3.0x10, 16 Atm
- Maverick 2.5x20, 12 Atm
Final result
Always One Stent?

A Provisional

B 2 stents?
Make everything as simple as possible, but not simpler.

Albert Einstein (1879-1955)
In < 15% of Cases a Systematic Two Stents Approach is Planned

Courtesy of Thierry Lefèvre
Two stent techniques:
Provisional T/TAP
Crush/Mini-crush;
V/SKS stenting;
Culotte stenting
Two stent techniques:

Provisional T/TAP

Crush/Mini-crush

Culotte stenting

V/SKS stenting;

Courtesy of John Ormiston
Bench Deployments Steep Distal Angles (110° eg L Main)
Four different stenting strategies
“T” stenting has best expansion at the carina
Kissing post-dilatation does not fully expand the stents in the ostium

 Courtesy of John Ormiston
Why Not Using a Provisional SB Approach Even When SB Stenting is Planned?
Main Branch Stenting First

- T-stenting
- TAP
- Internal Crush
- Culotte

Courtesy of Thierry Lefèvre
Main Branch Stenting First
Main Branch Stenting First
Main Branch Stenting First
Main Branch Stenting First
Main Branch Stenting First
Systematic Two Stents Approach
Starting with SB stent
Culotte stenting
Side branch first (S)

Baseline

Courtesy of O. Darremont
Lesion predilatation

Culotte stenting
Side branch first (S)
Culotte stenting
Side branch first (S)

Stent positioning and LCx stenting
Culotte stenting
Side branch first (S)

POT and LAD re-wiring through LCx stent
Culotte stenting
Side branch first (S)

Strut opening and LAD stent position AP-cranial
Culotte stenting
Side branch first (S)

LAD stenting
Culotte stenting
Side branch first (S)

Final kissing
Culotte stenting
Side branch first (S)

Final result
Technical Factors that May be Important in Reducing Restenosis & TLR when 2 Stents Implanted in Bifurcations

- High pressure side branch inflation;
- 2-step Kiss: Pre-FKI side branch dilatation;
- Use of low-compliant balloons;
- Less protrusion of SB stent into MB (mini-crush, DK-Crush);
- IVUS-guided stenting.
An approach for bifurcation lesions when using 2 stents as intention to treat

- **V-Stent**
  - Bifurcation lesion with no disease proximal to the bifurcation or very short left main

- **T/TAP-Stent**
  - Bifurcation lesion with main branch disease extending proximal to the bifurcation and side branch which has origin with about 90° angle

- **Mini Crush/Culotte**
  - Bifurcation lesion with main branch disease extending proximal to the bifurcation and side branch which has origin with about 60° angle

*Courtesy of A. Colombo*
Dedicated Bifurcation Devices

Dedicated bifurcation stent systems remain limited (EBC)
- Comparative RCTs vs. provisional stenting are lacking (ESC)

1. MB stenting with provisional SB stenting
   - Twin-Rail
   - NILE
   - Petal
   - Abbott’s SB Access DES
   - Antares®
   - SideKick
   - Stentys

2. Side branch stents
   - Capella Sideguard
   - Tryton

3. Proximal
   - Axxess

4. Bifurcated stent
   - Medtronic Y stent
Final Thoughts: The Approach to Bifurcation PCI

• The provisional approach of implanting one stent in the MB should be the default approach in most bifurcations lesions;

• A customized approach considering the size and extent of disease in the SB as well as its angulation is essential when dealing with complex bifurcation lesion.
Thank You