Techniques for LM Stenting

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Disclosure Statement of Financial Interest

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<table>
<thead>
<tr>
<th>Affiliation/Financial Relationship</th>
<th>Company</th>
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<tbody>
<tr>
<td>Grant/Research Support</td>
<td>Palmaz Scientific, Abbott, St Jude Medical, SCAI</td>
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<td>Consulting Fees/Honoraria</td>
<td>BSCI, Osprey Medical</td>
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<td>UTHSCSA</td>
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<td>Other Financial Benefit</td>
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Revascularization Of Left Main Coronary Artery : Topics

• Defining Left Main Disease
• Challenges of Left Main PCI
• What is "Optimal" Left Main PCI?
  Stent Design
  Approach
• Techniques for Left Main PCI :
  – Provisional vs. Elective Double Stenting
  – How to optimize results with provisional stenting
  – How to optimize results with elective double stenting
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4.8% of patients undergoing coronary angiogram
Male gender and Age are the only independent predictors
Associated with 3-VD in approx 50% of the cases
Isolated LMCA stenosis in 5%
  (more frequent in women)
UPLM: Lesion Location and Complexity

Ostial and Body Versus Distal Bifurcation

- Ostial: 23.6%
- Body: 73.7%
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Left Main Lesion Locations Per Patient
LM PCI Subset of SYNTAX Trial (N=357)

A) [Image]

B) [Image]

*Distal lesions defined as LM bi/trifurcation
Euroscore = 4
SYNTAX Score = 13

SYNTAX Score = 41
Euroscore = 6
The figure represents the distribution of SYNTAX Trial Patient Distribution for LM Patients. Here are the details:

- **LM CABG Registry (N=302):**
  - High: 19%
  - Intermediate: 5%
  - Low: 4%
- **LM PCI Registry (N=76):**
  - High: 2%
  - Intermediate: 23%
  - Low: 21%
- **LM RCT Patients (N=705):**
  - High: 26%
  - Intermediate: 18%
  - Low: 21%

The procedures are categorized as follows:

- **CABG:** 45%
- **PCI:** 55%

SYNTAX Scores:
- High: \( \geq 33 \)
- Intermediate: 23-32
- Low: \( \leq 22 \)
UPLM
SYNTAX to 4 years

Score 0-32

Score >32
Complexity of the lesion
LM Bifurcation vs Non-Bifurcation Stenting

Angiographic Restenosis

<table>
<thead>
<tr>
<th>Bifurcation</th>
<th>Non-bifurcation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2%</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

TLR at 3 Year

<table>
<thead>
<tr>
<th>Bifurcation</th>
<th>Non-bifurcation</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8%</td>
<td>1.2%</td>
</tr>
</tbody>
</table>

Angiographic F/U in 82.7% (BMS) and 79.5% (DES)

- **BMS**:
  - Total: 31.6%
  - Bifurcation: 7.2%
  - Non-bifurcation: 10.2%

- **DES**:
  - Total: 47.4%
  - Bifurcation: 22.1%
  - Non-bifurcation: 1.7%

P-values:
- LM Bifurcation vs Non-Bifurcation: P=0.043
- Total: P<0.001
- Bifurcation: P=0.024

**DES group**
Korean Experience

Freedom from TLR (%)

\[ p \text{ (log-rank)} = 0.3841 \]
Ostial and Shaft lesions

- Either Femoral or Radial Access
- Guide Support
  - Avoid trauma by “Deep Throating”
  - May choose larger guide for stability
- Single DES
- Careful stent placement
  - LAO cranial or biplane imaging
  - Stop mid-respiration
  - Consider “Rapid” pacing
    - rate of 100-120
UPLM Bifurcation lesions

• Represent majority (80%) of LM lesions
• Technique resembles non-left main bifurcations but requires more attention to details
  • Review cine and case with colleagues
  • Consider lesion preparation
• Bifurcation Angle is important
  • Average LAD/D1 angle is <60°
  • Average LMS/CX angle is >90°
Why is bifurcation angle so important?

- Metal fatigue with acute angle predisposes to strut fracture
- Areas of low shear stress promote restenosis
Technical issues
Bifurcation LMCA stenting

- Technically more challenging than Ostial lesions
  - Guide choice is critical
    - May need to have active seating
    - If using two stents consider larger guide
  - Highest restenosis, particularly when complex stent is used, occurring at the LCX ostium in most of the cases
Technical issues
Bifurcation LMCA stenting

• Technically more challenging
  • The strategy will differ according to anatomical issues:
    • bifurcation lesion, angles, relative differences re vessel sizes
  • Different bifurcation techniques (Provisional T-stenting, Crush stenting, T-stenting, V-stenting)

• Cross Over Stenting
  • preferred when there is no significant disease in the LCX ostium, regardless of the size of the ULMCA
Lesion Preparation

• Left main lesions
  • More calcified
  • More fibrous
  • Greater angulation

• Thoughtful approach and good lesion preparation critically important for success
Lesion preparation

- Rotational atherectomy
- Cutting balloons
- Scoring balloons
- High pressure non-compliant balloons
Bifurcation lesion - UPLM

Baseline

Rotablator
Bifurcation lesion -

Result after PRCA and POBA
Bifurcation lesion - ULM

Stent deployment
UPLM Target lesion Revascularization Rates

Toyofuku et al, J-Cypher Registry, Eurointervention 2011
### UPLM

#### One vs Two stents

<table>
<thead>
<tr>
<th></th>
<th>LMCA bifurcation</th>
<th>One-stent</th>
<th>Two-stent</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesion-level n</strong></td>
<td></td>
<td>741</td>
<td>204</td>
<td></td>
</tr>
<tr>
<td><strong>TLR (%)</strong></td>
<td></td>
<td>39/701 (5.6)</td>
<td>46/190 (24.2)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td><strong>Definite ST (%)</strong></td>
<td></td>
<td>1/698 (0.1)</td>
<td>5/188 (2.7)</td>
<td>0.002</td>
</tr>
<tr>
<td>Early ST (1-30 days)</td>
<td></td>
<td>0 (0.0)</td>
<td>2 (1.0)</td>
<td>0.046</td>
</tr>
<tr>
<td>Late ST (31-365 days)</td>
<td></td>
<td>1 (0.1)</td>
<td>3 (1.5)</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>Patient-level n</strong></td>
<td></td>
<td>741</td>
<td>204</td>
<td></td>
</tr>
<tr>
<td><strong>All-cause death (%)</strong></td>
<td></td>
<td>43 (5.8)</td>
<td>18 (8.8)</td>
<td>0.15</td>
</tr>
<tr>
<td><strong>Cardiac death (%)</strong></td>
<td></td>
<td>22/720 (3.1)</td>
<td>14/200 (7.0)</td>
<td>0.021</td>
</tr>
<tr>
<td><strong>MI (%)</strong></td>
<td></td>
<td>8/698 (1.2)</td>
<td>6/190 (3.2)</td>
<td>0.091</td>
</tr>
<tr>
<td><strong>Cardiac death or MI (%)</strong></td>
<td></td>
<td>30/720 (4.2)</td>
<td>16/200 (8.0)</td>
<td>0.03</td>
</tr>
</tbody>
</table>

*Toyofuku et al, J-Cypher Registry, Eurointervention 2011*
Double Stenting Techniques

• T Stenting
• Crush Technique
• Culotte Technique
• V stenting
• Simultaneous Kissing Stenting (SKS)
## Variants of T-Stenting

<table>
<thead>
<tr>
<th></th>
<th>Elective</th>
<th>Provisional</th>
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</thead>
<tbody>
<tr>
<td><strong>Classic-T</strong></td>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Variant-T</strong></td>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Modified-T</strong></td>
<td><img src="image5.png" alt="Diagram" /></td>
<td><img src="image6.png" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>TAP</strong></td>
<td><img src="image7.png" alt="Diagram" /></td>
<td><img src="image8.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>
Provisional Modified T-Stenting

“TAP” Technique

Burzotta F et al. CCI 70:75–82 (2007)
Crush stenting

1: Wire both branches and predilate if needed

2: Advance the 2 stents. MB stent positioned proximally. The SB stent will protrude only minimally into MB.
Crush stenting

3: Deploy the SB stent

4: Check for optimal result in the SB and then remove balloon and wire from SB. Deploy the MB stent
Crush stenting

5: Rewire the SB and perform high pressure dilatation

6: Perform final kissing balloon inflation
Crush Stenting

Crush technique: 3.0x33 Cypher in Cx and 3.5x18 Cypher in LAD.
Crush Stenting
Final result after kissing
The (Mini) Crush Technique

• Advantages
  – Guarantees the complete coverage of the SB ostium while ensuring the patency of both branches throughout the procedure.
  – Has been utilized in the RCTs.

• Disadvantages
  – Need to rewire the SB
  – Excessive metal (3 layers) in the MB proximal to the origin of the SB which can complicate rewiring and balloon re-crossing.
UPLM Bifurcation Stent Simple approach

• A single stent will almost always suffice when:
  • The circumflex is small
  • The Medina classification is x,x,0
    • (i.e. either the LAD or Cx ostium is not diseased)
  • Any ostial LAD or Cx disease is short

• >80% of LMS bifurcation lesions can be treated with a single stent
UPLM STENT STRATEGIES

- Ostial and shaft lesions
- Bifurcation lesions
- Lesion preparation
Why Does PCI of Coronary Bifurcations Remain a Challenge?

Side Branch Compromise / Occlusion

- Side branch occlusion (SBO) after PCI of bifurcation lesions is common (~7-20%) and is associated with increased incidence of non-Q wave MI.

- SBO occurs more often in complex bifurcations and increases with increasing severity of the side branch stenosis.
IMAGING GUIDANCE

- Sizing of Stent for Left Main
- Stent expansion/apposition
- Aid in assessing lesion significance
Sizing

- Simplest role of IVUS
- Possibly the most important?
- Angiography systematically “undersizes” LMS
Stent expansion/apposition

- Angiography will miss incomplete apposition
Use of IVUS in UPLM

Park SJ, Circulation 2010
HEMODYNAMIC SUPPORT

• When might haemodynamic support be indicated for UPLM interventions?
  • Depressed LV function
  • Sole remaining vessel
  • Rotational Atherectomy
What hemodynamic support?

- IABP
- Impella
- LV assist devices
UPLM
LV Support in Stable Cases

• Plan vascular access
• IABP availability useful
  • Especially useful if LV poor
  • Can “buy time” if complications occur
    • Vessel dissection
    • Slow flow
    • Vessel closure
• Radial operator – groin ready for access
• Vascular access complications may limit potential benefit
### BCIS I Revascularisation Details

<table>
<thead>
<tr>
<th></th>
<th>Elective IABP</th>
<th>No Planned IABP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedural Success</td>
<td>94%</td>
<td>93%</td>
</tr>
<tr>
<td><strong>No. of Vessels treated</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 vessel</td>
<td>73 (48%)</td>
<td>69 (46%)</td>
</tr>
<tr>
<td>2 vessels</td>
<td>64 (42%)</td>
<td>64 (43%)</td>
</tr>
<tr>
<td>3 vessels</td>
<td>13 (9%)</td>
<td>16 (11%)</td>
</tr>
<tr>
<td><strong>Coronary Segment treated</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left Main Stem</td>
<td>35 (23%)</td>
<td>41 (27%)</td>
</tr>
<tr>
<td>Proximal LAD</td>
<td>73 (48%)</td>
<td>71 (47%)</td>
</tr>
<tr>
<td>Lesions treated (mean ± SD)</td>
<td>2.15 ± 1.04</td>
<td>2.05 ± 1.02</td>
</tr>
<tr>
<td>Rotational Atherectomy</td>
<td>20 (13%)</td>
<td>17 (11%)</td>
</tr>
<tr>
<td>Drug-eluting stent use</td>
<td>67%</td>
<td>67%</td>
</tr>
<tr>
<td>GP2b3a inhibitor use</td>
<td>39%</td>
<td>43%</td>
</tr>
</tbody>
</table>
BCIS I All-cause Mortality
by treatment assignment

Hazard ratio 0.66 (95% CI 0.44 to 0.98)
Shock II Trial
Primary Study Endpoint (30-Day Mortality)

~90% of IABPs inserted after PCI…
PROTECT II

- IABP vs Impella in high risk PCI (25% LM)
- No difference in MACE between groups but perhaps a difference in non PRCA group

Per Protocol (N=374)

Log rank test, $p=0.005$
PCI for UPLM: Summary

- Current angiographic bifurcation classifications are not well tested in left main lesions.
- 4 out of 5 large RCTs comparing provisional to elective double stenting (EDS) included only low-risk (non left main) bifurcation lesions.
- Provisional SB stenting should be the default technique in most patients with left main stenosis.
- Elective double stenting of the MV and SB may be preferable to provisional stenting in selected patients with “high-risk” distal left main bifurcations.
CONCLUSIONS

• Case review and selection is critical
• Choice of access and guides should be based upon anatomy and planned intervention
• For the UPLM bifurcation, single stent strategies are still preferred and should yield acceptable results for >80% of cases
• Lesion preparation/vessel modification may be needed for successful procedure
• IVUS guidance should be considered and may improve clinical outcomes
• Hemodynamic support remains clinically useful in selected high risk individual patients
Thank You

Questions?