Η Βέλτιστη Στρατηγική στην Αγγειοπλαστική Στελέχους

Σοφία Βαϊνά

Α’ Καρδιολογική Κλινική του Πανεπιστημίου Αθηνών, Ιπποκράτειο
Recommendation for the Type of Revascularization in pts with LM

Franz-Josef Neumann et al. European Heart Journal 2018

<table>
<thead>
<tr>
<th>Recommendations according to extent of CAD</th>
<th>CABG</th>
<th>PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class</td>
<td>Level</td>
</tr>
<tr>
<td>One-vessel CAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without proximal LAD stenosis.</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td>With proximal LAD stenosis.</td>
<td>I</td>
<td>A</td>
</tr>
</tbody>
</table>

| Two-vessel CAD                             |      |      |      |      |
| Without proximal LAD stenosis.             | IIb  | C    | I    | C    |
| With proximal LAD stenosis.                | I    | B    | I    | C    |

| Left main CAD                              |      |      |      |      |
| Left main disease with low SYNTAX score (0 - 22). | I    | A    | I    | A    |
| Left main disease with intermediate SYNTAX score (23 - 32). | I    | A    | IIa  | A    |
| Left main disease with high SYNTAX score (≥33). | I    | A    | III  | B    |
Contemporary Use and Trends in Unprotected Left Main Coronary Artery PCI in the US

3,342,162 patients from 1,662 institutions in the NCDR CathPCI Registry.

- Just 1.0% of all PCIs performed in the US between 2009 and 2016 were for unprotected left main CAD
- On average, operators performed just 0.5 such cases each year; only 16.5% did more than one case annually
- Patients treated were older and had more comorbidities than those observed in the EXCEL and NOBLE trials

**Conclusion:** Use of PCI for left main CAD is modest and occurs more frequently in highly selected patients.
LM disease is a challenging subset for PCI.

Lesions of the mid-shaft of the LM are fairly straightforward, but they are also uncommon.

Instead, the disease more typically involves the aorto-ostium with heavy calcification.

Or the disease involves the distal bifurcation with all of the associated challenges of any bifurcation lesion with the exception that the "side branch" is a major epicardial vessel.

This is particularly problematic in left-dominant circulations, as the large mass of myocardium subtended by the LM may cause hemodynamic collapse during intervention.
Left Main Bifurcation

Left Main disease involves the bifurcation in 80% of the cases, usually extending from the LMCA to the LAD
Left Main Bifurcation is a More Challenging Lesion

Figure 3 Characteristics of the left main coronary artery bifurcation which makes it a more challenging lesion than other non-left main coronary artery bifurcations. (A) A case example of notable mismatch between the left main coronary artery and the left anterior descending artery, hampering the selection of an adequately sized stent (e.g., a large diameter stent sized to the left main coronary artery implanted across the left circumflex may result in dissection or perforation of the left anterior descending artery; a smaller diameter stent sized to the left anterior descending artery may result in malapposition in the left main coronary artery). (B) A case example of left main coronary artery disease in a left-dominant coronary system, jeopardizing a large territory of myocardium.
<table>
<thead>
<tr>
<th></th>
<th>p Value</th>
<th>HR (95% CI)</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major 1: Distal LM bifurcation: SB-DS ≥70% and SB lesion length ≥10 mm</td>
<td>&lt;0.001</td>
<td>55.2 (21.005-79.437)</td>
<td>80</td>
<td>72</td>
</tr>
<tr>
<td>Major 2: Non-LM bifurcation: SB-DS ≥90% and SB lesion length ≥10 mm</td>
<td>&lt;0.001</td>
<td>66.3 (12.708-98.184)</td>
<td>80</td>
<td>74</td>
</tr>
<tr>
<td>Minor 1: Moderate to severe calcification</td>
<td>0.002</td>
<td>38.7 (24.516-72.695)</td>
<td>64</td>
<td>65</td>
</tr>
<tr>
<td>Minor 2: Multiple lesions</td>
<td>0.007</td>
<td>26.8 (4.322-57.004)</td>
<td>68</td>
<td>60</td>
</tr>
<tr>
<td>Minor 3: Bifurcation angle &lt;45°</td>
<td>0.004</td>
<td>14.1 (9.245-18.018)</td>
<td>64</td>
<td>53</td>
</tr>
<tr>
<td>Minor 4: Main vessel RVD &lt;2.5 mm</td>
<td>0.010</td>
<td>9.4 (7.556-14.814)</td>
<td>69</td>
<td>58</td>
</tr>
<tr>
<td>Minor 5: Thrombus-containing lesions</td>
<td>0.002</td>
<td>27.2 (4.662-78.301)</td>
<td>66</td>
<td>64</td>
</tr>
<tr>
<td>Minor 6: MV lesion length ≥25 mm</td>
<td>0.010</td>
<td>6.9 (3.879-12.398)</td>
<td>57</td>
<td>66</td>
</tr>
<tr>
<td>Major 1 + any 2 minor 1-6 = complex</td>
<td></td>
<td></td>
<td>87</td>
<td>83</td>
</tr>
<tr>
<td>Major 2 + any 2 minor 1-6 = complex</td>
<td></td>
<td></td>
<td>88</td>
<td>83</td>
</tr>
</tbody>
</table>
Proposed Algorithm for Strategy Choices in LM PCI

LMCA bifurcation

SB lesion <70% and/or lesion length <10 mm

SB lesion ≥70% and/or lesion length >10 mm

Rab T et al. JACC Cardiovasc Interv 2017;10:849-865
Proposed Algorithm for Strategy Choices in LM PCI

LMCA bifurcation

SB lesion < 70% and/or lesion length < 10 mm

Difficult SB access

Easy SB access

Rab T et al. JACC Cardiovasc Interv 2017;10:849-865
Proposed Algorithm for Strategy Choices in LM PCI

- LMCA bifurcation

- SB lesion <70% and/or lesion length <10 mm

- Difficult SB access

- 2 stents
  - SB stent first
  - Inverted Culotte

Rab T et al. JACC Cardiovasc Interv 2017;10:849-865
Proposed Algorithm for Strategy Choices in LM PCI

LMCA bifurcation

SB lesion <70% and/or lesion length <10 mm

Easy SB access

Provisional 1 stent With SB compromise

Provisional 1 stent Without SB compromise

Rab T et al. JACC Cardiovasc Interv 2017;10:849-865
Proposed Algorithm for Strategy Choices in LM PCI

LMCA bifurcation

- SB lesion <70% and/or lesion length <10 mm
  - Easy SB access
    - Provisional 1 stent
      - With SB compromise
        - 2 stents T/TAP
      - Without SB compromise
        - 2 stents Culotte

*Rab T et al. JACC Cardiovasc Interv 2017;10:849-865*
Proposed Algorithm for Strategy Choices in LM PCI

LMCA bifurcation

- SB lesion ≥70% and/or lesion length >10 mm
- 2 stents
  - SB stent first
  - DK-crush

Rab T et al. JACC Cardiovasc Interv 2017;10:849-865
Proposed Algorithm for Strategy Choices in LM PCI

LMCA bifurcation

- SB lesion <70% and/or lesion length <10 mm
  - Difficult SB access
    - Provisional 1 stent With SB compromise
      - 2 stents SB stent first Inverted Culotte
  - Easy SB access
    - Provisional 1 stent Without SB compromise
      - 2 stents T/TAP

- SB lesion ≥70% and/or lesion length >10 mm
  - 2 stents Culotte
  - 2 stents SB stent first DK-crush
### Table 2. Maximal stent expansion of some contemporary DES according to the manufacturers' instructions for use (IFU).

<table>
<thead>
<tr>
<th>DES type</th>
<th>DES sizes</th>
<th>Maximal expansion according to IFU</th>
</tr>
</thead>
<tbody>
<tr>
<td>XIENCE Sierra</td>
<td>2.25-3.25 mm</td>
<td>3.75 mm</td>
</tr>
<tr>
<td></td>
<td>3.5-4.0 mm</td>
<td>5.50 mm</td>
</tr>
<tr>
<td>Resolute Onyx</td>
<td>2.25-2.5 mm</td>
<td>3.25 mm</td>
</tr>
<tr>
<td></td>
<td>2.75-3.0 mm</td>
<td>3.75 mm</td>
</tr>
<tr>
<td></td>
<td>3.5-4.0 mm</td>
<td>4.75 mm</td>
</tr>
<tr>
<td></td>
<td>4.5-5.0 mm</td>
<td>5.75 mm</td>
</tr>
<tr>
<td>SYNERGY</td>
<td>2.25-2.75 mm</td>
<td>3.50 mm</td>
</tr>
<tr>
<td></td>
<td>3.0-3.5 mm</td>
<td>4.25 mm</td>
</tr>
<tr>
<td></td>
<td>4.0 mm</td>
<td>5.75 mm</td>
</tr>
<tr>
<td>Ultimaster</td>
<td>2.25-3.0 mm</td>
<td>3.50 mm*</td>
</tr>
<tr>
<td></td>
<td>3.5-4.0 mm</td>
<td>4.50 mm*</td>
</tr>
<tr>
<td>Orsiro</td>
<td>2.25-3.0 mm</td>
<td>3.50 mm</td>
</tr>
<tr>
<td></td>
<td>3.5-4.0 mm</td>
<td>4.50 mm</td>
</tr>
</tbody>
</table>
**Double Kissing Crush or DK Crush Technique:**

1. Side branch (SB) stenting with short main branch protrusion of 2 to 3 mm. Balloon maintained in main branch across SB ostium.

2. SB stent balloon crush by main vessel balloon.

3. SB wire withdrawal.

4. SB wire proximal recrossing.

5. High-pressure dilatation of SB ostium followed by first kissing balloon inflation.

6. Main branch stenting across the SB after SB wire is removed.

7. Proximal optimization technique (POT).

8. Second SB wire recrossing through the main branch stent and the crushed SB stent.

9. Sequential balloon inflations to 16 atmospheres followed by second kissing balloon inflations to 12 atmospheres each, followed by simultaneous deflations.

10. Re-POT.

11. Final result.

---

*Rab T et al. JACC Cardiovasc Interv 2017;10:849-865*
CENTRAL ILLUSTRATION  Stenting for LM Bifurcations

Simple Lesions

Complex Lesions

Plus Any Two of:

- Multiple Bifurcations
- Thrombus-Containing
- MV RVD ≤2.5 mm
- MV Lesion Length ≥25 mm
- Severe Calcification
- Bifurcation Angle ≥70° or
- Bifurcation Angle ≤45°

1-Year TLF

Provisional 8.0% 95% CI: 0.31-1.49

DK Crush 3.9%

1-Year TLF

Provisional 18.2% 95% CI: 0.05-0.54

DK Crush 7.0%

p for Interaction = 0.65

WHICH PROVISIONAL IN DK-CRUSH V?

**LCx QCA:**
- %DS ~ 65%
- MLD ~ 1 mm

**Study Design:**
- 484 patients with unprotected LM bifurcations
- Medina 1,1,1 and Medina 0,1,1

**Provisional stenting**
- DK crush stenting

**SB Pre-dilation discouraged**

**Kissing in the case of:**
- SB TIMI < 3
- SB Dissection
- SB stenosis > 75%

**-> 40% Provisional (vs. 68% DK-CRUSH !!!)**

**-> kissing not done in > 20% of Provisional**

Who should perform ULM PCI? The DKCRUSH-V trial required the primary operators to have performed $\geq$300 PCIs per year for 5 years, including at least 20 left main PCIs per year. These numbers are unrealistic for many U.S. operators, because the median annual PCI volume in the United States is 59 cases, and 44% of U.S. operators perform $<50$ PCIs per year (3). Although there is ongoing conversation about expanding PCI volume in the United States, the population of left main operators is relatively small. The DKCRUSH-V trial included 21 operators with a median of 19.5 PCIs per year. Of these, 6 operators performed $\geq$300 PCIs per year. Therefore, the DCIRUS-V trial may need to be expanded to include physicians with $\geq$300 PCIs per year experience.

THE PAIN

DK crush has many steps and can be challenging to perform. First, it may be difficult to rewire the side.
**EBC MAIN**

- The European Bifurcation Club Left Main Coronary Study - a randomised comparison of Single versus Dual Stenting for True Bifurcation Left Main Coronary Lesions

**SINGLE STENT**
- Provisional, according to EBC Consensus
- POT mandated
- Kiss mandated

**DUAL STENT**
- Operator choice (T, TAP, culotte, minicrush)
- Ancillary aspects - as per EBC Consensus
- High pressure "ostial" dilatations
Proximal Optimization Technique is Indispensable!!!

<table>
<thead>
<tr>
<th>Diameter of smaller daughter vessel (mm)</th>
<th>Diameter of larger daughter vessel (in terms of the main stent sizes in use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.25</td>
<td>3.03 3.20 3.39 3.58 3.78 3.99 4.20 4.42</td>
</tr>
<tr>
<td>2.50</td>
<td>3.36 3.54 3.72 3.91 4.11 4.32 4.53</td>
</tr>
<tr>
<td>2.75</td>
<td>3.70 3.87 4.06 4.25 4.44 4.84</td>
</tr>
<tr>
<td>3.00</td>
<td>4.04 4.21 4.39 4.58 4.77</td>
</tr>
<tr>
<td>3.25</td>
<td>4.37 4.55 4.73 4.91</td>
</tr>
<tr>
<td>3.50</td>
<td>4.71 4.88 5.06</td>
</tr>
<tr>
<td>3.75</td>
<td>5.05 5.22</td>
</tr>
<tr>
<td>4.00</td>
<td>5.38</td>
</tr>
</tbody>
</table>

Lassen JF et al. EuroIntervention 2014;10:545-560
Two Mechanisms of Stent Longitudinal Distortion When Stenting the LM:

(1) The balloon delivery system or post-dilatation balloon is pulled back too early after deflation.

(2) Pull-back of the jailed wire may deeply intubate the guiding catheter and damage the stent.

Rab T et al. JACC Cardiovasc Interv 2017;10:849-865
Left Main PCI with 2-Stent Technique: The Role of IVUS

CENTRAL ILLUSTRATION: Algorithm for Left Main Bifurcation Intervention

LM Bifurcation

SB lesion <70% and/or lesion length <10 mm

Simple lesion

Easy SB access

No

Yes

Provisional or Inverted Provisional (EBC consensus)

2 stents SB stent first Inverted Culotte

2 stents T/TAP or Culotte

SB compromise FFR ≤0.80 <TIMI 3 flow

1 stent

2 stents SB stent first DK-Crush (ABC consensus)

IVUS/OCT imaging strongly recommended after LM Stenting

The risk of ischaemic events possibly related to suboptimal antiplatelet therapy while awaiting surgery is <0.1%, while that of perioperative bleeding complications associated with platelet inhibitors is >10%.
Bifurcation Left Main Treatment Strategy
Provisional Stenting
Bifurcation Left Main Treatment Strategy
Provisional Stenting
Bifurcation Left Main Treatment Strategy
Provisional Stenting
Bifurcation Left Main Treatment Strategy
Provisional Stenting
Bifurcation Left Main Treatment Strategy
Provisional Stenting
Bifurcation Left Main Treatment Strategy
Provisional Stenting
Bifurcation Left Main Treatment Strategy
Provisional Stenting
Bifurcation Left Main Treatment Strategy
Provisional Stenting
Bifurcation Left Main Treatment Strategy
Provisional Stenting
Bifurcation Left Main Treatment Strategy
TAP Technique
Bifurcation Left Main Treatment Strategy
TAP Technique
Bifurcation Left Main Treatment Strategy
TAP Technique
Bifurcation Left Main Treatment Strategy
TAP Technique
Bifurcation Left Main Treatment Strategy
TAP Technique
Bifurcation Left Main Treatment Strategy
TAP Technique
Bifurcation Left Main Treatment Strategy
TAP Technique
Bifurcation Left Main Treatment Strategy
Reverse TAP Technique
Bifurcation Left Main Treatment Strategy
Reverse TAP Technique
Bifurcation Left Main Treatment Strategy
Reverse TAP Technique
Bifurcation Left Main Treatment Strategy
Reverse TAP Technique
Bifurcation Left Main Treatment Strategy
Reverse TAP Technique
Bifurcation Left Main Treatment Strategy - Provisional Stenting
Non-ST-elevation Acute Coronary Syndrome
Bifurcation Left Main Treatment Strategy - Provisional Stenting
Non-ST-elevation Acute Coronary Syndrome
Bifurcation Left Main Treatment Strategy - Provisional Stenting
Non-ST-elevation Acute Coronary Syndrome
Bifurcation Left Main Treatment Strategy - Provisional Stenting
Non-ST-elevation Acute Coronary Syndrome
Βασικές Αρχές στην Τοποθέτηση Stent

1. Σύρμα και στα δύο αγγεία
2. Προδιαστολή στο στέλεχος με το κυρίως αγγείο που θα τοποθετηθεί το stent
3. Καλή προετοιμασία της στένωσης αν χρειαστεί με cutting/rota
4. Η επιλογή του stent βασίζεται στο μέγεθος κυρίως αγγείου και όχι στο μέγεθος του στελέχους
5. Αν χρειαστεί kissing balloon πρώτα διαδοχικές προδιαστολές στους δύο κλάδους ξεχωριστα σε υψηλές ατμόσφαιρες και μετά kissing σε χαμηλές ατμόσφαιρες
6. POT σε όλο του μήκους του στελέχους που έχει τοποθετηθεί stent
7. Συνιστάται η χρήση IVUS ή OCT για την καθοδήγηση της αγγειοπλαστικής στο στέλεχος
Η πιο καλή στρατηγική είναι η πιο απλή τεχνική

Provisional stenting αρχικά στις περισσότερες περιπτώσεις περιπτώσεις

Αναλόγως σταδιακά μπορεί να χρειαστεί πιο πολύπλοκη τεχνική με δύο stent

Σε λίγες περιπτώσεις είναι απαραίτητη από την αρχή η χρήση δύο stent

Όταν χρειάζονται δύο stent, η τεχνική DK-crush ίσως να είναι η προτιμώμενη