Kissing balloon inflation in single- or two-stent bifurcation stenting

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What is the role of kissing balloon inflation in the bifurcation intervention?

• To keep the access route to the SB
• To prevent SB narrowing and restenosis
• To make a bigger lumen in the proximal MV
• To assure the stent apposition
• To correct the stent deformation
Keeping the access route to the SB

Final KBT
Correction of stent deformation

Lefevre T, Albiero R, 2nd European Bifurcation Club, 2006

Stent deformation during strut opening

Can be corrected simply by “kissing balloon” inflation with lower pressure in the SB if necessary (8 vs 12 atm)
Effect of KBT on restenosis in 2-stent technique

Crush stent

T-stent

P=0.03

P=0.04

## Culotte stenting: Predictors of binary restenosis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proximal main vessel</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference vessel diameter decrease by 1 mm</td>
<td>4.55 (0.17–123.36)</td>
<td>0.37</td>
</tr>
<tr>
<td>Baseline stenosis increase by 10%</td>
<td>0.91 (0.67–1.23)</td>
<td>0.54</td>
</tr>
<tr>
<td><strong>Distal main vessel</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference vessel diameter decrease by 1 mm</td>
<td>0.10 (0.00–3.17)</td>
<td>0.19</td>
</tr>
<tr>
<td>Baseline stenosis increase by 10%</td>
<td><strong>1.47</strong> (1.03–2.09)</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>Side branch vessel</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference vessel diameter decrease by 1 mm</td>
<td><strong>31.83</strong> (1.71–592.77)</td>
<td>0.02</td>
</tr>
<tr>
<td>Baseline stenosis increase by 10%</td>
<td>0.97 (0.82–1.15)</td>
<td>0.75</td>
</tr>
<tr>
<td><strong>Kissing balloon post-dilatation</strong></td>
<td><strong>0.37</strong> (0.13–1.10)</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Adriaenssens T, Eur Heart J; 29: 2868
Various Techniques for Stenting Bifurcation Lesions

- Stent+POBA
- T stenting
- Provisional-T

KBT is mandatory.

Culotte

Y or V

Crush

Kissing
2Y clinical outcome of GISE survey on unprotected LMCA

Ineffectiveness of FKB on the MACE in 1-stent strategy

**COBIS**

Korean Coronary Bifurcation Stenting Registry

- No FKB: 4.7%
- FKB: 8.7%

n=940, n=458

Gwon HC, ACC 2009

**Nordic – Baltic III**

- No FKB: 2.9%
- FKB: 2.9%

n=239, n=238

Niemela M, Circulation. 2011; 123: 79
Does kissing balloon inflation always have a good performance?

If good, what’s the best kissing technique?
Nordic – Baltic III
Angiographic restenosis in 8mo follow-up

True bifurcation

<table>
<thead>
<tr>
<th></th>
<th>MV</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Non-true bifurcation

<table>
<thead>
<tr>
<th></th>
<th>MV</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1%</td>
<td>5%</td>
</tr>
</tbody>
</table>

P = 0.024

Niemela M, Circulation. 2011; 123: 79
COBIS: Location of TLR

Gwon HC, EBC 2009
Various configurations of the proximal MV stent which are dependent on the operator’s decision.
Effect of bifurcation angle on stent overlapping style

Before stenting

- 30°: Lateral position
- 70°: Longitudinal cross over
- 80°: X-shape cross over

Stent inflation

Murasato Y, EBC 2009
Relationship between bifurcation angle and vessel dilation in the proximal MV

Cross section in the proximal MV

Longitudinal overlapping

X-shape

More overdilation and gap formation

Murasato Y, EBC 2009
Two overlapping styles in KBT

Minimal overlapping + Proximal large ballooning

- ML Vision 3.5/28, 14atm
- SB Ryujin 3.0/20, 12atm
- KBT (6atm)
  MV Ryujin 3.5/20
  SB Ryujin 3.0/20
- prox MV
  Quantum Maverick II
  4.5/8, 12atm

Long overlapping

- ML Vision 3.5/28, 14atm
- SB Ryujin 3.0/20, 12atm
- KBT (6atm)
  MV Ryujin 3.5/20
  SB Ryujin 3.0/20

Mitsudo’s law

\[ 3.5^2 + 3.0^2 = 4.6^2 \]

Murasato Y, EBC 2009
Minimal overlapping + Proximal large ballooning

Long overlapping

Murasato Y, EBC 2009
Wall Shear Stress

Optimal dilation

Proximal over-dilation

*Velocity prior to parabolic inflow 0 m/s

Segre J, EBC 2007 © Minvasys 2007
Optimal result for the bifurcation is obtained by minimal overlapping.

Possibility of balloon injury

Murasato Y, EBC 2009
Semi-compliant vs. Non-compliant balloon

Risk of edge dissection

Kinoshita Y, EBC 2009
2-link stent
Y-shape, long overlapping KBI
Cross sectional view

Endeavor 3.0/24
KBI (3.5+3.0/20, 8atm)

Wide opening for the SB

Balloon overlapping changed from lateral to longitudinal position.

Murasato Y, Euro PCR 2010
3-link stent
Y-shape, long overlapping KBI

Stent structure was maintained in the KBI site.

Cross sectional view

Balloon overlapping changed from lateral to longitudinal position.

ML Zeta 3.5/28
KBI (3.5+3.0/20, 8atm)

Murasato Y, Euro PCR 2010
3-link stent
Y-shape, long overlapping KBI

When the vertical link was in the SB ostium, the jailed strut remained at the site where the SB balloon crossed over the MV balloon.

Murasato Y, Euro PCR 2010
Polymer injury of DES after bifurcation stenting

SB ostium after “crush” and “kissing” with large balloons and multiple inflations at 20 atm

Ormiston J, AP summit 2005

Does polymer injury limit the efficacy of DES?
Deformation of stent and polymer damage after KB inflation

Guérin P. Circ Cardiovasc Interv, 2010, 3, 120

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cypher</td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
</tr>
<tr>
<td>Cypher Select</td>
<td><img src="#" alt="Image" /></td>
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<td><img src="#" alt="Image" /></td>
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</table>
• KB inflation caused oval-shaped dilation with the eccentricity value of 0.75 and 30% enlargement was obtained compared to distal site.

• In the KB inflation site, metal / artery ratio was decreased as well as drug delivery / surface ratio.

Table. Geometric Analysis of DES Deformation After Kissing Postdilatation

<table>
<thead>
<tr>
<th></th>
<th>Eccentricity, PS</th>
<th>Enlargement, % PS vs DS</th>
<th>PS Metal/Artery Ratio (Normal*/Kissing), %</th>
<th>Drug Delivery/Surface Ratio (Normal*/Kissing), μg/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cypher</td>
<td>0.72±0.01</td>
<td>0.78±0.01</td>
<td>31±2</td>
<td>12.7/8.8</td>
</tr>
<tr>
<td>Cypher Select</td>
<td>0.66±0.03</td>
<td>0.73±0.01</td>
<td>24±3</td>
<td>13.5/10.2</td>
</tr>
<tr>
<td>Endeavour</td>
<td>0.72±0.01</td>
<td>0.75±0.03</td>
<td>30±3</td>
<td>19.0/13.3</td>
</tr>
<tr>
<td>Taxus Express</td>
<td>0.69±0.02</td>
<td>0.75±0.00</td>
<td>28±3</td>
<td>20.5/14.7</td>
</tr>
<tr>
<td>Taxus Liberté</td>
<td>0.72±0.04</td>
<td>0.75±0.02</td>
<td>30±4</td>
<td>17.9/12.5</td>
</tr>
</tbody>
</table>

Data are presented as mean±SD. The calculated value of the constant (A) and geometric parameters for each type of DES are shown. *Normal value of DES declared by the manufacturer at nominal diameter.
The improvement in expansion and access abilities may result in the increase in polymer damage as reversed results.
Take home messages

• FKB is necessary for the 2-stent technique in order to complete the stent apposition and obtain enough luminal area.
• However, FKB after the 1-stent technique does not always assure good long-term results.
• Asymmetrical overdilation of proximal MV induced by FKB may lead to frequent restenosis.
  – Dissection in proximal edge and SB ostium
  – Polymer damage
  – Rheological disadvantage
• Optimal FKB is obtained in the following fashion.
  – Minimal overlapping
  – Gentle kiss
  – If necessary, use a short large balloon for the proximal MV
Be a good kisser!
Thank you for your attention.