When and how to treat the side branch in provisional stenting

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Disclosure Statement of Financial Interest

Within the past 12 months, I have received consulting fees / honoraria from the following:

– Cordis, Johnson & Johnson
– Abbott Vascular
– The Medicines Company
– Boston Scientific
Provisional stenting: the concept

1. Protect the side branch with a wire
2. Dilate and stent the main vessel
3. Evaluate the result in the SB particularly the flow
4. If necessary, re-wire the SB to optimise with kissing balloon post-dilatation
5. Perform stent implantation to the SB if poor result particularly if TIMI 0 or 1 flow

When?
WHAT...YOU THINK I'VE GOT ALL THE ANSWERS?
Desiderius Erasmus of Rotterdam, Dutch Humanist and Theologian (1466-1536) coined the phrase “prevention is better than the cure”.

“it is better to stop something bad happening than it is to deal with it after it has happened.”
Wire the side branch

- Compromise of SB occurs to some extent unpredictably

**Predictors of Side Branch Failure**
*Insights from the TULIPE Study (n=186)*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Success</th>
<th>Failure</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>66 ± 11</td>
<td>57 ± 8</td>
<td>0.0007</td>
</tr>
<tr>
<td>MB ref diameter (mm)</td>
<td>3.1 ± 0.4</td>
<td>2.8 ± 0.3</td>
<td>0.0085</td>
</tr>
<tr>
<td>SB ref diameter (mm)</td>
<td>2.5 ± 0.5</td>
<td>2.2 ± 0.3</td>
<td>0.0413</td>
</tr>
<tr>
<td>Final kissing balloon (%)</td>
<td>98.1</td>
<td>76.5</td>
<td>0.0019</td>
</tr>
<tr>
<td>Jailed wire (%)</td>
<td>92.9</td>
<td>71.4</td>
<td>0.031</td>
</tr>
</tbody>
</table>

Brunel et al CCI 68:67-73
Why wire the side branch?

- Favorable modification of the side branch angulation after wiring
  - the lesion becomes Y shape
Always use 2 wires!

62 year old man with NYHA II stable angina
Always use 2 wires!

- Severe chest pain
- ST elevation in lateral leads
- CK rise of 800
When do we need to treat the SB?

- Ostium SB stenosis is overestimated by angio

QCA versus FFR

- Visual estimate / QCA of the significance of stenosis of the SB ostium is unreliable

Courtesy of Dr Remo Albeiro
When do we need to balloon the SB in provisional stenting?

- Is final kissing balloon dilatation mandatory?
  - Await the results of randomised studies (NORDIC KISS and CROSS)

- < TIMI 3 flow

- “Significantly stenosed”........?

- Must be performed optimally
  - After dilatation of SB, kissing balloon dilatation is essential to correct the MV stent deformation
When do we need to stent the SB?

- Crossover to a 2nd stent in the provisional stenting group of randomised studies

When do we need to stent the SB?

- SB DS ≥50%
- Severe stenosis &/or major flow-limiting dissection
- TIMI 0 flow after balloon dilatation
- SB DS ≥50%
- Type B of worse dissection
- TIMI flow ≤2

Colombo et al Circ 2004; Pan et al AHJ 2004; Steigen et al Circ 2006; Colombo et al
Provisional stenting: MACE rates

Colombo et al Circ 2004; Pan et al AHJ 2004; Jensen et al Eurointervention 2008; Colombo et al
When do we need to stent the SB?

- Long lesion (eg >10mm) in an important vessel
- Significant (≥type C) dissection
- TIMI 0 or 1 flow
- Significantly stenosed..............?

Final result after Culotte stenting
Assess the angulation

Y-shape incidence ~ 75%

Ostial restenosis was associated with incomplete coverage

✓ Culotte
✓ Crush

✗ T-stent

Lemos et al Circulation 2003;108:257-60
Importance of lesion coverage

• 178 consecutive patients undergoing provisional stenting
• 80 (45%) required a 2nd stent, and were treated with either Culotte (n=45) or T-stenting (n=35)
• FU angio at 6 months
• Mean bifurcation angle was 57 ± 22°

Kaplan et al Am Heart J 2007;154:336-43
Crush stenting: influence of bifurcation angle

Influence of bifurcation angle on outcome following use of the crush technique

MACE-free survival (%)

“Y”-shape
“T”-shape

Dzavik et al AHJ 2006;152:762-9
### Culotte stenting

<table>
<thead>
<tr>
<th>Independent predictors of binary restenosis</th>
<th>Odds ratio (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (increase of 10 years)</td>
<td>2.38 (1.21-4.96)</td>
<td>0.01</td>
</tr>
<tr>
<td>Bifurcation angle (increase of 10°)</td>
<td>1.53 (1.04-2.23)</td>
<td>0.03</td>
</tr>
<tr>
<td>Baseline main vessel DS (increase of 10%)</td>
<td>1.47 (1.03-2.09)</td>
<td>0.03</td>
</tr>
<tr>
<td>SB ref. vessel diameter (decrease by 1mm)</td>
<td>31.83 (1.71-592.77)</td>
<td>0.02</td>
</tr>
<tr>
<td>Kissing balloon post-dilatation</td>
<td>0.37 (0.13-1.10)</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Adriaenssens et al EHJ 2008;29:2868-76
Stents don`t like large bends.

Maximal inflation pressure was biased in the central core of the balloon and did not change during inflation.

- Dumbbell shape
- Gap

- T-stenting
- Mini-crush

Courtesy of Dr Murasato
Mini-crush

- Relatively straightforward technique, appears suitable irrespective of bifurcation angle
- Registry data of 457 patients

<table>
<thead>
<tr>
<th></th>
<th>9 month angio FU</th>
<th>2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. pts</td>
<td>MV binary restenosis (%)</td>
<td>SB binary restenosis (%)</td>
</tr>
<tr>
<td>T-stent 2-stents</td>
<td>88</td>
<td>19</td>
</tr>
</tbody>
</table>

“These results may confirm the advantage of using prescheduled 2-stent technique to give a complete coverage of the side branches` ostium”

* p≤0.001, **p≤0.01

TAP: T-stenting & small protrusion

- 73 patients
  - Mortality rate 4%
  - AMI 0
  - TLR: 7%
  - 1 definite and 1 suspected stent thrombosis

- MACE-free survival at 9-months 90%

Burzotti et al CCI 2007;70:75-82
## Choice of stenting strategy for the SB: importance of the angle

<table>
<thead>
<tr>
<th></th>
<th>T-shape bifurcation</th>
<th>Y-shape bifurcation</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-stenting</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>Internal crush</td>
<td>X</td>
<td>√</td>
</tr>
<tr>
<td>Culotte</td>
<td>X</td>
<td>√</td>
</tr>
<tr>
<td>TAP</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>
Final kissing balloon post-dilatation

- Significant reduction in MV and SB restenosis
- Must be performed optimally using appropriately sized balloons:
  - Sequential high pressure balloon dilatation of the SB stent then MV stent
  - Finalise with lower pressure kissing balloon dilatation
Summary & Conclusions

1. Try to avoid SB compromise in the first place
   - Pre-wire the SB especially if high angle and/or significant SB disease at baseline

2. Avoid pre-dilatation of the SB

3. Significance of any “stenosis” in the ostium of the SB is overestimated on angiography

4. Definite indications for use of a 2nd stent are reduced flow +/- significant dissection

5. When implanting a SB stent, choice of technique depends on the angulation
Thankyou!