FFR Evaluation of Bifurcation Lesions

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Bifurcation (side branch lesion) is very unique in 30 years of PCI history.....

- Stenting is not better than angioplasty
- Angioplasty is not better than “leave it alone”

NORDIC III: Leave it alone vs Kissing

NORDIC III: Leave it alone vs Kissing
Pitfalls of anatomical evaluation

• Angiography
  – Single directional assessment
  – Variability in stenosis assessment
  – No validated criteria for side branch intervention

• IVUS/OCT
  – Can not be performed in tight stenosis (ex. jailed SB)
  – No validated criteria for side branch intervention
  – Not physiologic
Why “Physiologic evaluation”? 

• Various size, different myocardial territory
• Side branch ostial lesion is unique
  – Underlying plaque → Eccentric plaque
  – Remodeling → Negative remodeling
  – Mechanisms of luminal narrowing
    • Stent struts
    • Shifted plaque
    • Shifted carina
### Medina Classification?

<table>
<thead>
<tr>
<th></th>
<th>Minimal Dm</th>
<th>Reference Dm</th>
<th>% diameter stenosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Main</td>
<td>2.0</td>
<td>4.1</td>
<td>53%</td>
</tr>
<tr>
<td>LAD</td>
<td>0.63</td>
<td>3.28</td>
<td>81%</td>
</tr>
<tr>
<td>RI</td>
<td>0.6</td>
<td>2.16</td>
<td>72%</td>
</tr>
<tr>
<td>LCX</td>
<td>1.18</td>
<td>2.85</td>
<td>58%</td>
</tr>
</tbody>
</table>

Distal Left Main

- Min LA 5.1mm²
- Ref LA 17.8mm²

LCX ostium

- Min LA 2.5mm²
- Ref LA 6.4mm²

1, 1, 1, 1
Angiographic severity vs. Functional significance

<table>
<thead>
<tr>
<th>FFR</th>
<th>≥70% Angiographic Stenosis</th>
<th>50%–70% Angiographic Stenosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥0.75</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>&lt;0.75</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

Sensitivity 100%, specificity 55%, and test accuracy 60%.

FFR in ostial lesion
Bifurcation lesion?
Bifurcation lesion?

CT angiography: 1VD (RCA)
Coronary angiography: 1VD (RCA)
Functional Medina Classification?

0, 1, 0, 0
Jailed Side Branches
Angiographic severity vs. Presence of Ischemia

Severe stenosis, but no perfusion defect!
FFR vs. % diameter stenosis in Jailed side branches

SNUH SB-FFR registry, N=153

Functionally significant
Which one is functionally significant?
Should we measure FFR in these lesions?

FFR=0.67

FFR=0.93

FFR=0.95

FFR=0.92

FFR=0.74

Courtesy of Dr Colombo and Dr Airoldi
Anatomical severity vs. Functional significance

- Jailed LCX ostial disease (N=25) -

\[ R = -0.639 \]
\[ P = 0.001 \]
FFR in Bifurcation intervention

Before PCI

After MB stenting

After kissing balloon

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Anatomical severity vs. Functional significance

- Lumen area vs. FFR in SB after angioplasty -

Lumen Area: 2.0mm$^2$
MLD: 1.2mm

Lumen Area: 6.5mm$^2$
Lumen area vs. FFR in Jailed SB after angioplasty

Lumen Area: 2.3mm²
MLD: 1.2mm

Lumen Area: 6.5mm²

Reference
Changing of side branch FFR after kissing ballooning

(Side branch balloon/artery ratio: $0.85 \pm 0.14$)

Post-Stent: $0.65 \pm 0.08$
Post-Kissing: $0.85 \pm 0.06$

$P < 0.001$

Functional outcome of Jailed side branches

Not-treated jailed side branches

![Graph showing fractional flow reserve over time with post-PCI and follow-up values: 0.87 ± 0.06 and 0.89 ± 0.07 with a P-value of 0.1]
Safety?

SNUH experience

- Side branch FFR (n=810)
  - CFR, IMR (n=178)
- Main branch FFR (n=2186)

- Death: 0
- MI: 0
- Major dissection: 1
- Dissection requiring stenting: 0

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FFR in Bifurcation lesion

- FFR-guided PCI for bifurcation lesion is safe and feasible.

- FFR is helpful from the beginning to the “fine tuning” of PCI procedures in bifurcation lesions.