IVUS Insights for the Treatment of Bifurcation and Left Main Lesions

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Pre-intervention Assessment
If you want to quantify the degree of lumen compromise, you must image the daughter branches directly.
# IVUS assessment of LCX ostium from the LAD-LM (or vice versa) – plaque burden

<table>
<thead>
<tr>
<th>Evaluation of the LAD from the LM-LCX pullback</th>
<th>Evaluation of the LCX from the LM-LAD pullback</th>
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<tbody>
<tr>
<td></td>
<td>Sensitivity</td>
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<tr>
<td>Plaque burden &gt;4 0%</td>
<td>59%</td>
</tr>
<tr>
<td>Plaque burden &gt;7 0%</td>
<td>78%</td>
</tr>
</tbody>
</table>

*If you want to quantify the plaque burden, you must image the daughter branches directly.*

Oviedo et al. Am J Cardiol 2010;105:948-54
• **In 25% of patients, the left main MLA differs by 1mm² when imaged from a pullback beginning in the LAD vs a pullback beginning in the LCX.**

• **Since IVUS can artificially increase, but not decrease lumen dimensions, the smallest MLA is always the most accurate.**
- Plaque shifting during bifurcation intervention is a misconception. The carina is almost always free of disease; and conventional angiographic classifications are almost always misleading. Instead, the carina is deflected and “reset” and the ostium of a sidebranch (with or without a stent) is distorted.
  - The carina is more compliant that the eccentric plaque opposite the flow divider
  - Negative remodeling may contribute to this phenomenon
- IVUS shows more diffuse disease, especially continuous plaque from the the LM into the LAD.
IVUS plaque distribution in 140 distal LMCA bifurcation lesions

Oviedo et al. Circ Cardiovasc Interv 2010;3:105-12
Medina 1,1,1 (n=21)
Medina 1,1,0 (n=9)
Medina 1,0,1 (n=6)
Medina 0,1,1 (n=11)
Medina 1,0,0 (n=7)
Medina 0,1,0 (n=14)
Medina 0,0,1 (n=12)
Medina 0,0,0 (n=60)

All lesions (n=80)

Others
IVUS determinants of LMCA FFR <0.75

IVUS assessment of LM disease significance is based on lumen dimensions, not plaque burden

Plaque burden (P&M/EEM) = 68%
MLA=7.2mm$^2$
Post-intervention assessment
975 pts with unprotected LMCA stenosis underwent elective stenting under IVUS (n=756) or angiographic (n=219) guidance and were followed for 3 years.

IVUS-guidance was significantly associated with reduced death (HR=0.31 overall and HR=0.27 in DES) as compared with angiography guidance.

In 201 propensity score-matched pairs of pts in the overall cohort, there was a tendency for reduced 3-year mortality with IVUS-guidance compared with angiography guidance (6.0% vs. 13.6%, HR=0.54).

In 145 propensity score-matched pairs of pts treated with DES, 3-year mortality was lower with IVUS-guidance as compared with angiography-guidance (4.7% vs. 16.0%, HR=0.39, p=0.048).

However, the use of IVUS-guidance did not reduce the risk of myocardial infarction or target vessel revascularization.

Impact of IVUS Guidance on All-Cause Mortality After LMCA DES Implantation

Cumulative Incidence (%)

- **IVUS (n=595)**: 95.2%
- **No IVUS (n=210)**: 85.6%

*HR=0.43, p=0.019*

*Park et al. TCT 2007*
"Optimal" MSA and TLR after LMCA DES Implantation (n=595)

Minimum stent area (mm$^2$)

(Park et al. TCT 2008)
Pre-intervention  Post-intervention
Forty patients with bifurcation lesions underwent crush-stenting. Postintervention IVUS was performed in both branches in 25 lesions and only the main vessel in 15 lesions.

- When only the main vessel was considered, MSA was found in the crush area (rather than the proximal or distal part of the main vessel stent) in 56%.
- When both the MV and the SB were considered, the MSA was found at the SB ostium in 68%.

Incomplete crushing – incomplete apposition of the SB or MV stent struts against the MV wall proximal to the carina, found in >60% of non-LM lesions.
Serial IVUS (post-intervention and follow-up) analysis of the main and sidebranches in 73 bifurcation lesions treated DES T-stenting

- Stent expansion was significantly less in the SB than in the MV (87.1±20.4% vs. 97.0±29.1%, p=0.007).
- The SB ostium was the most frequent site of the post-procedural MSA.
- At the SB ostium, follow-up MLA correlated with post-procedural MSA (r=0.805, p <0.001).
- The percentage of neointimal area was higher at the SB ostium than at the MV proximal, MV distal, and SB distal stent (p<0.0001).
- The optimal threshold of post-procedural MSA to predict follow-up MLA ≥4mm$^2$ at the SB ostium was 4.83mm$^2$, yielding an area under the curve of 0.88 (95% confidence interval: 0.80 to 0.95).

Correlation Between Follow-Up MLA vs Post-Procedural MSA

Percentage of Neointimal Hyperplasia in the Sidebranch and Main Vessel

The Optimal Cutoff Value of Post-Procedural MSA to Predict a Follow-up MLA ≥4mm² After Bifurcation T-Stenting

AUC=0.88 (95%CH=0.80-0.95)  
AUC=0.81 (95%CH=0.64-0.99)
Pre-intervention

Post-intervention
There was a negative correlation between the % stenosis on QCA and FFR ($r=-0.41$, $p<0.001$).

Only 27% of lesions with QCA DS >75% were functionally significant as assessed by FFR (<0.75).