The ABC’s of intravascular imaging in contemporary lower limb revascularization: the Japanese experience

Osamu Iida, MD, FACC
Kansai Rosai Hospital, Cardiovascular Center
Amagasaki, Hyogo, Japan
Speaker name:

Osamu Iida, MD

I have the following potential conflicts of interest to report:

- Consulting
- Employment in industry
- Stockholder of a healthcare company
- Owner of a healthcare company
- Other(s)
- I do not have any potential conflict of interest
Basic Structure of Artery

Adventitia

Medial membrane

Intima, atheroma or internal elastic membrane

EEM (External Elastic Membrane) = the border between

Internal lumen (MSA: minimum stent area or MLA: minimum lumen area)
How to measure vessel diameter by IVUS?

IVUS-measured vessel diameter is basically defined as “EEM-based” not “lumen based” evaluation (diameter of this case is 6.4mm*6.7mm).
What information can IVUS provide in FP intervention?

Situation: After successful wire crossing

Accurate vessel diameter measurements

In principle, the angiography-measured vessel diameter is "lumen-based", whereas IVUS evaluation of the vessel diameter is "external elastic membrane (EEM)-based"

IVUS-measured vessel diameter: 7.9m. * 8.4mm

IVUS-measured vessel diameter: 6.4mm

Detailed evaluation for plaque characteristics

Plaque characteristics strongly influence decision making regarding 1) treatment strategy, 2) technical approach, 3) device selection and 4) prediction of long-term success

- Thrombus
- Fibrous
- Calcification (eccentric)
- Calcification (concentric)
Apparent difference between the vessel diameter (VD) assessed by angiography and that by IVUS in FP-EVT

Association of angiography-assessed VD with the difference between angiography- and IVUS-assessed VD (n=1725)

IVUS-assessed VD was significantly larger than angiography-assessed RVD (6.0 ± 1.0 mm versus 5.0 ± 1.0 mm; P<0.001). ΔRVD was 1 mm or larger in 48.8% (46.5% to 51.0%) of the whole population. The difference of IVUS- versus angiography-assessed VD was more marked in cases with a smaller angiography-assessed VD.

Work in progress
## Association of anatomical factors with IVUS- minus angiography-assessed RVD of 1 mm or larger

The association of anatomical factors with $\Delta$RVD $\geq$1 mm (n=1725)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Unadjusted odds ratio</th>
<th>Adjusted odds ratio</th>
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<tbody>
<tr>
<td>Popliteal lesion</td>
<td>1.61 [1.31 to 1.96] (P&lt;0.001)</td>
<td>1.20 [0.95 to 1.51] (P=0.13)</td>
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<tr>
<td><strong>Angiography-assessed RVD (per 1 mm)</strong></td>
<td>0.38 [0.34 to 0.43] (P&lt;0.001)</td>
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<tr>
<td>Chronic total occlusion</td>
<td>0.78 [0.65 to 0.94] (P=0.008)</td>
<td>0.63 [0.50 to 0.80] (P&lt;0.001)</td>
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<tr>
<td>Lesion length (per 10 cm)</td>
<td>1.06 [0.97 to 1.16] (P=0.19)</td>
<td>1.01 [0.90 to 1.14] (P=0.81)</td>
</tr>
<tr>
<td>Angiography-assessed calcification (versus none)</td>
<td>1.00 (Ref)</td>
<td>1.00 (Ref)</td>
</tr>
<tr>
<td>Unilateral calcification</td>
<td>1.20 [0.97 to 1.50] (P=0.099)</td>
<td>1.18 [0.93 to 1.51] (P=0.18)</td>
</tr>
<tr>
<td><strong>Bilateral calcification</strong></td>
<td><strong>1.34 [1.08 to 1.67] (P=0.008)</strong></td>
<td><strong>1.36 [1.06 to 1.74] (P=0.014)</strong></td>
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<tr>
<td>History of revascularization (versus never)</td>
<td>1.00 (Ref)</td>
<td>1.00 (Ref)</td>
</tr>
<tr>
<td>History of plain angioplasty</td>
<td>0.90 [0.50 to 1.62] (P=0.73)</td>
<td>0.66 [0.34 to 1.27] (P=0.21)</td>
</tr>
<tr>
<td><strong>History of stent implantation</strong></td>
<td><strong>1.86 [1.39 to 2.51] (P&lt;0.001)</strong></td>
<td><strong>1.72 [1.23 to 2.41] (P=0.001)</strong></td>
</tr>
</tbody>
</table>

A smaller angiography-assessed RVD, a lesion without chronic total occlusion, angiography-assessed bilateral calcification, and history of stent implantation were significantly associated with $\Delta$RVD $\geq$1 mm.
Question: Which DCB size are you going to select for this CTO treatment?
*QVA shows: distal reference vessel diameter was 3.2mm.
*IVUS shows EEM diameter was 5.6mm*6.4mm, while lumen diameter 4.4mm*5.4mm.
Select 1:1 DCB size to the distal reference EEM diameter as assessed by IVUS and complete the procedure with more than 3 minutes of inflation.
The IVUS-guided group was treated with a larger balloon size for all types of below-the-knee vessel (p < .001)
What information can IVUS provide in FP intervention?

Situation: After successful wire crossing

**Accurate vessel diameter measurements**

In principle, the angiography-measured vessel diameter is "lumen-based", whereas IVUS evaluation of the vessel diameter is "external elastic membrane (EEM)-based"

**Detailed evaluation for plaque characteristics**

Plaque characteristics strongly influence decision making regarding 1) treatment strategy, 2) technical approach, 3) device selection and 4) prediction of long-term success
Clinical scenario of calcified FP-CTO
-Calcification increases a risk of procedural and clinical failure-
Question: Which balloon size are you going to select for vessel prep (VP), 6mm, 7mm, 8mm?

IVUS-guided “EEM+1mm approach” for scaffold strategy
IVUS-guided "Leave Scaffold Behind" strategy

Proximal reference
- EEM: 7.9*8.0mm (49.7mm²)
- Lumen: 5.7*6.3mm (28.5mm²)

Minimum lumen area
- Lumen: 1.6*2.3mm (2.8mm²)

Distal reference
- EEM: 6.4*6.7mm (33.2mm²)
- Lumen: 5.2*5.4mm (22.7mm²)
IVUS-guided “EEM+1mm approach” for scaffold strategy

Size of balloon for “aggressive vessel prep” was selected +1mm larger than distal EEM diameter (6.4mm*6.7mm).
IVUS-guided “EEM+1mm approach” for scaffold strategy
Take home message

✓ IVUS-assessed VD was significantly larger than angiography-assessed RVD (6.0 ± 1.0 mm versus 5.0 ± 1.0 mm; P<0.001).

✓ The difference of IVUS- versus angiography-assessed VD was more marked in cases with a smaller angiography-assessed VD.

✓ A smaller angiography-assessed RVD, a lesion without chronic total occlusion, angiography-assessed bilateral calcification, and history of stent implantation were significantly associated with ΔRVD ≥1 mm.

✓ I generally select 1:1 DCB size to the distal reference EEM diameter as assessed by IVUS and complete the procedure with more than 3 minutes of inflation.

✓ I generally select EEM+1mm larger balloon for vessel preparation when leave scaffold strategy is determined in especially calcified lesions.
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