Basics of Angiographic Interpretation
Analysis of Angiography

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What made us nervous...
What we do in angiographic analysis?

Qualitative and Quantitative Measurement of Angiography taken at preprocedure, postprocedure and follow-up
Good Angiography
The first for good analysis and technique dependent

- Angiography is only as good as the quality of the images taken
- Comprehensive diagnostic - no omissions
- Multiple views - foreshortening and overlap
- Catheter caliber - contrast streaming
- IC Nitroglycerin - vasospasm
# Case Report Form of Angiographic Analysis

**CardioVascular Research Foundation, Seoul**

## Study Information
- **Study name:**
- **Site:**
- **Patient ID:**
- **Cath date:**

## Image
- **Catheter frame #**
- **Arterial frame #**

## Qualitative Measurement

### Morphology
- **Eccentric**
- **Bend**
- **Thrombus**
- **Tortuosity**
- **Calcification**
- **Ulceration**
- **Aneurysm**
- **Intimal flap**
- **Ectasia**

### QCA
- **Prox Normal**
- **Distal Normal**
- **Inter normal**
- **MLD**
- **Lesion length**

## Procedure

### Pre-PTCA
- **Frames**
- **Frames (corr)**

### Bifurcation
- **Side branch**
- **SBPreDS**

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**CVRF CardioVascular Research Foundation**

Asan Medical Center
Angiography remains a gold standard

- Identifies lesion characters and complications of PCI
- TIMI flow
- Collateral circulation
- Distal embolization
- Vasospasm
- Dissections
- Slow/No reflow
- Perforations
Angiography: limitations are real

- Thrombus
- Extent of Calcium
- Severity of Intermediate Lesions
- Unstable/vulnerable plaque
- Bifurcation Lesions
- Can not provides functional data
Thrombus Visualization with a Freeze-frame
Thrombus and Calcium Diagnostic Considerations

• Thrombus
  ▪ Angiography: low sensitivity, high specificity
  ▪ Angioscopy is best diagnostic tool

• Calcium
  ▪ Angiography: low sensitivity for mild/moderate Ca, Moderate sensitivity for severe Ca
  ▪ IVUS is best diagnostic tool
Stenosis or Not at Ostial LCX?
# Case Report Form of Angiographic Analysis in CardioVascular Research Foundation, Seoul

## Cardiac Research Foundation

<table>
<thead>
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## Quantitative Measurement

### Morphology
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### PRE-PROCEDURE
- **Pre-TIMI Frames**
- **Frames**
- **Frames (corr)**
- **Bifurcation**
- **Side branch**
- **SBPreDS**

### QCA
- **Prox Normal**
- **Distal Normal**
- **MLD**
- **Lesion length**

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Director / Fellow / Technician | Date
---|---
Surrogate End Points
As Quantitative Angiographic Measurements

- Minimal luminal diameter (MLD)
- Late loss
- Diameter stenosis
- Binary angiographic restenosis

- A reliable substitute for clinical end points in smaller studies
- To speed up trial progress
Interpolated Reference
standard to assess the degree of stenosis

- MLD = 1.3
- Mean reference: (3.5+2.2) / 2 = 2.85
  DS = (2.85-1.3) / 2.85 X 100 = 54.4%
- Interpolated reference: 3.2
  DS = (3.2-1.3) / 3.2 X 100 = 59.4%

- MLD = 0.5
- Mean reference: (3.5+2.2) / 2 = 2.85
  DS = (2.85-0.5) / 2.85 X 100 = 82.5%
- Interpolated reference: 2.5
  DS = (2.5-0.5) / 2.5 X 100 = 80.0%
Definition of Late Loss
Post-procedure MLD – F/U MLD

- Within the stent (in-stent)
- Within the analysis segment (in-segment)
- Within the segment, but separately considering the stented segment, proximal and distal edges and taking the maximum change in MLD within those 3 segments and applying it to this segment as a whole (maximal regional late loss)

Ellis SG et al. J Am Coll Cardiol 2005;45:1193
## Late Loss

<table>
<thead>
<tr>
<th></th>
<th>Proximal edge</th>
<th>In-stent</th>
<th>Distal edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-procedure MLD, mm</td>
<td>2.7</td>
<td>3.0</td>
<td>3.1</td>
</tr>
<tr>
<td>F/U MLD, mm</td>
<td>2.4</td>
<td>2.2</td>
<td>1.8</td>
</tr>
<tr>
<td>Difference, mm</td>
<td>0.3</td>
<td>0.8</td>
<td>1.3</td>
</tr>
</tbody>
</table>

- **In-stent late loss**: $3.0 - 2.2 = 0.8$
- **In-segment late loss**: $2.7 - 1.8 = 0.9$ mm
- **Maximal regional late loss**: 1.3 mm
Advantage of Late Loss

- Useful indirect measurement of intimal growth
- No dependency of reference diameter
- Less patients to demonstrate the efficacy of device than restenosis or clinical outcomes
In-Segment vs. In-Stent Late Loss

• **In-stent late loss**
  - Reflect only the pure biologic potency of an antirestenotic device

• **In-segment late loss**
  - Potency of an antirestenotic device
  - Effect of margins of stents due to balloon injury and drug diffusion effects, etc
Negative Late Loss
What does it mean?

Potential Limitation of LL Indicating Intimal Growth

- LL does not indicate the intimal growth at the same site.
- Practically, standard techniques of measuring late loss have compared MLDs from a specified zone in in-stent, edge, or in-segment.
Measurement Error of LL
due to 2 measures from 2 different angiograms

- Different guiding catheters: 7Fr vs. 5Fr
- Not same projections

We need well-trained personnel, well-developed protocol, and monitoring program in measurement...
The "Step down" phenomenon is a major limitation of Standard QCA when applied to bifurcation analyses.
What does the late loss mean in bifurcation? Is it the LM, LAD, or LCX?

Left main coronary artery stenosis

- Acute Gain: BMS 2.06 vs. SES 2.73, \( P < 0.001 \)
- Late Loss: BMS 1.27 vs. SES 0.05, \( P < 0.001 \)
Late loss is only meaningful if the segment analyzed is specified

1 – Proximal Edge of the Prox PV Stent
2 – Prox PV Stent
3 – Distal PV Stent*
4 – Distal Edge of the PV Stent
5 – SB Stent*
6 – Distal Edge of the SB Stent*
7 – Carina
8 – Ostium of the SB (5mm)
9 – PV In-Lesion
10 – SB In-Lesion

*if additional stent(s) placed

## Dedicated Bifurcation QCA Software

- **CardioVascular Research Foundation**
- **Asan Medical Center**

### Bifurcation Segment Model

![Bifurcation Model](image)

### Ref A (mm²) | Plaque A (mm²) | %A (%)
--- | --- | ---
Darina | 4.55 | 0.53 | 12

### Ratio Dist/Prox at Ostium

<table>
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<tr>
<th>Luminal</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murray</td>
<td>Finet</td>
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<tr>
<td>-</td>
<td>-</td>
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</tbody>
</table>

### Prox pos (mm) | Length (mm) | %D (%) | Min D (mm) | Max D (mm) | Mean D (mm) | Ref D (mm)
--- | --- | --- | --- | --- | --- | ---
1 | 0.00 | 4.97 | 7.16 | 1.88 | 2.46 | 2.21 | 2.03
2 | 4.97 | 2.59 | 4.56 | 1.40 | 2.39 | 2.07 | 1.46
3 | 7.56 | 8.23 | 38.29 | 0.83 | 1.40 | 1.08 | 1.34
4 | 15.80 | 4.98 | 16.54 | 1.24 | 1.75 | 1.54 | 1.48
5 | 7.67 | 5.91 | 19.84 | 1.03 | 1.46 | 1.28 | 1.28
6 | 13.58 | 5.00 | 11.07 | 1.20 | 1.37 | 1.29 | 1.35
7 Main | 5.13 | 2.43 | 4.56 | 1.40 | - | - | 1.46
7 Side | 5.13 | 2.54 | 4.56 | 1.40 | - | - | 1.46
8 | 7.67 | 2.03 | 19.84 | 1.03 | 1.36 | 1.20 | 1.28
9 | 0.00 | 20.78 | 38.29 | 0.83 | 2.46 | 1.57 | 1.34
10 | 7.67 | 10.91 | 19.84 | 1.03 | 1.46 | 1.28 | 1.28

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**JEONG HYEONG JIN**

- **ID**: 27288695
- **Birthdate**: 1931-4-8
- **Physician**: Asan Medical Center 4411
- **Hospital**: Rang
- **Acquisition Date**: 2006-8-7
- **Patient Orientation**: L/R
- **II Size**: 16.00 cm

- **Segment**: Nonostial
- **Trial Name**: Intervention
- **Analysis type**: Nonostial
- **Cat. Factor**: 0.133 mm²/kg
- **Cat. Object**: 7.00 French Catheter

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**CVRF CardioVascular Research Foundation**

**Asan Medical Center**
Why do we need Core Lab?

- Scientific support
- Technical support
- Standard guideline
- Research resources
- Training
- Etc.