IVUS Analysis

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- Intimal disease (plaque) is dense and will appear “white”
- Media is made of homogeneous smooth muscle cells and does not reflect ultrasound (appears dark)
- Adventitia has “sheets” of collagen that reflect a lot of ultrasound (appears white)
Classification of Plaque by IVUS

- Soft Plaque
- Fibrous Plaque
- Fibro-calcific Plaque
Normal
Soft plaque

- Not as bright as the adventitia (hypoechoic)
- “Soft” refers to the low echogenicity, generally due to high lipid content in a mostly cellular lesion
Fibrous plaque

- As bright or brighter than the adventitia (hyperechoic)
- Majority of lesions are fibrotic
Calcium

- Bright echos (brighter than the adventitia)
- Obstructs the penetration of ultrasound (acoustic shadowing)
- Only the leading edge is detected and thickness cannot be determined
Deep calcium
Other Interesting Images
Intracoronary Thrombus
Incomplete stent apposition
Fibrous cap with lipid core
Hematoma
Quantitative IVUS Analysis

Non-stented segment

*PM Area = (EEM-Lumen) Area
Classification of Remodeling

Positive remodeling

Intermediate remodeling

Negative remodeling

Proximal reference
Lesion site
Distal reference

Nishioka. *JACC* 1996
Definitions of Remodeling

- Lesion/Average Reference EEM CSA
  - Positive remodeling: >1.05
  - No Remodeling: 0.95-1.05
  - Negative remodeling: <0.95
EEM CSA = 20.4
Lumen CSA = 9.7
P+M CSA = 10.7
Max lumen diam = 3.7
MLD = 3.1
Eccentricity = 1.0/0.3
Plaque burden = 0.52
Arc of Ca = 60

EEM CSA = 21.6
Lumen CSA = 4.5
P+M CSA = 17.1
Max lumen diam = 32.8
MLD = 2.3
Eccentricity = 3.0/0.1
Plaque burden = 0.79

EEM CSA = 13.3
Lumen CSA = 8.9
P+M CSA = 4.4
Max lumen diam = 3.6
MLD = 3.0
Eccentricity = 0.6/0.2
Plaque burden = 0.33

Average Reference EEM CSA = 16.9
Remodeling Index = 1.3
=> Positive Remodeling
Quantitative IVUS Analysis

Stented segment

- Stent Area (mm$^2$)
- Lumen Area (mm$^2$)
- Neointimal Area (mm$^2$)
IVUS vs. Angiography
LIMITATIONS OF CORONARY ANGIOGRAPHY

Focal disease

Diffuse disease

50% lesion

50% lesion
Angiographically Silent Disease

In 884 native coronary arteries, the plaque burden in the angiographically “normal” reference segment was 51 ± 13%

LIMITATIONS OF CORONARY ANGIOGRAPHY

Coronary Cross-section

Angiogram silhouette

75%

25%
### Irregular Plaque / Irregular Lumen

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<th>Cross Section</th>
<th>RAO View</th>
<th>LAO View</th>
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Limitation of coronary Angiography

“Poor inter-observer Correlation”

CASS Study

Fisher et al, CCD 1982
IVUS arc of target lesion calcification

% of lesions

- $0^\circ$ to $<90^\circ$: 27%
- $91^\circ$ to $180^\circ$: 26%
- $181^\circ$ to $270^\circ$: 21%
- $271^\circ$ to $360^\circ$: 27%

IVUS eccentricity index

Eccentricity index = max/min P + M thickness

Mintz et al. Circulation 1996;93:924-931