OCT for optimization of coronary interventions: why, how and when?

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WHY IS IMAGING SO IMPORTANT?

CALCIUM

• Calcific lesions present in 90% by age 70
• Ca underdiagnosed by angio
• Ca detected by angio in 38% pts, 73% by IVUS in same pts
• OCT sensitivity increased up to 90-100%
• Ca increases stent under-expansion and MACE

Calcified Nodule with High-Pressure Balloon
4.0 x 12 DES and Post Dil 4.0 x 8 NC
OCT-based ALGORITHM FOR THE TREATMENT OF CALCIFIED LESIONS

- OCT
  - Deep
  - Superficial
  - Nodular

- CVI Score I-III
- CVI Score IV (>180° arc, >5mm long, >0.5mm thick)

- Balloon crossable
- Balloon uncrossable

- NC/Scoring/Cutting balloon
- IVL
- Calcium fracture on OCT
- RA or OA

- Stent
- Final OCT

CALCIUM MODIFICATION

- **Deep**
  - NC/SCORING/CUTTING

- **Superficial**
  - ROTATIONAL/ORBITAL/LITHOTRIPSY/EXCIMER LASER

- **Nodular**
  - TRADITIONAL ATERECTOMY ROTATIONAL/ORBITAL
LET’S FOLLOW THE ALGORITHM IN A CASE
OCT-based ALGORITHM FOR THE TREATMENT OF CALCIFIED LESIONS

- OCT
  - Deep
  - Superficial
  - Nodular
    - CVI Score I-III
    - CVI Score IV
      - (>180° arc, >5mm long, >0.5mm thick)
    - Balloon crossable
    - Balloon uncrossable
      - OCT and balloon uncrossable
        - RA or OA
          - Calcium fracture on OCT
            - No
            - Yes
              - Stent
              - Stent
                - Final OCT

- NC/Scoring/Cutting balloon
  - IVL
    - Final OCT
DEFINE TYPE CALCIUM...

CALCIUM SUPERFICIAL TO LUMEN. MINIMAL TO NO FIBROTIC LAYER

DEPTH OF CALCIUM LIKELY MEASURABLE

SUPERFICIAL CALCIUM
SCORE THE CALCIUM... TOTAL = 4 POINTS

1. Maximum Calcium Angle (°)
   360° ARC ➔ 2 points

2. Maximum Calcium Thickness (mm)
   1.31mm ➔ 1 point

3. Calcium Length (mm)
   9.90mm ➔ 1 point
OCT-based ALGORITHM FOR THE TREATMENT OF CALCIFIED LESIONS

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Superficial

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(>180° arc, >5mm long, >0.5mm thick)

Balloon crossable

Balloon uncrossable

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IVL

Calcium fracture on OCT

Final OCT

Stent

Stent

Final OCT

OCT and balloon uncrossable

RA or OA

No

Yes
WHAT ROLE-TECHNIQUE TO USE?

- BALLOON CROSSABLE?
  - YES: IV LITHOTRIPSY
  - NO: TRADITIONAL AHERECTOMY
    - ROTATIONAL/ORBITAL/EXCIMER LASER
OCT-based ALGORITHM FOR THE TREATMENT OF CALCIFIED LESIONS

OCT

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Balloon crossable

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Nodular

OCT

NC/Scoring/Cutting balloon

IVL

Calcium fracture on OCT

Final OCT

Stent

RA or OA

Yes

Stent

No

Stent
IMPACT OF LITHOTRIPSY ON CALCIUM

A. Baseline

A. Stenotic lesion, unable to dilate by standard high pressure balloon

B. Large luminal gain with multiple calcium fractures

C. Complete stent expansion and additional luminal gain with additional calcium fractures


* Frames are co-registered to ensure same location of cross-sections
SIZING FOR SUCCESS

MORPHOLOGY ➔ SUPERFICIAL CA^{2+}

LENGTH ➔ 22mm

SIZE ➔ 3.12mm

IVL SIZING 1:1

3.0X15mm
IV LITHOTRIPSY
EVIDENCE OF FRACTURE
OCT-based ALGORITHM FOR THE TREATMENT OF CALCIFIED LESIONS

1. OCT
   - Deep
   - Superficial
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2. CVI Score I-III
   - Balloon crossable
   - NC/Scoring/Cutting balloon

3. CVI Score IV
   - (>180° arc, >5mm long, >0.5mm thick)
   - Balloon uncrossable
   - OCT and balloon uncrossable

4. IVL
   - Calcium fracture on OCT

5. RA or OA

6. Final OCT
   - Yes
     - Stent
   - No
     - Stent

STENT PLACEMENT - DES 3.0 X 22 mm
FINAL OCT ASSESSMENT
OCT POST ASSESSMENT
EDGE – EXPANSION – APPOSITION

- NO DISTAL EDGE DISSECTION
- NO PROX EDGE DISSECTION
- 91% DISTAL EXPANSION
- 100% PROX EXPANSION
- COMPLETE APPOSITION
OCT Assessment of ISR

Underexpansion

1:1 Balloon Dilatable

1:1 Balloon Un-Dilatable

IVL/ELCA

1:1 NC Balloon

Expansion Confirmation via OCT

Yes

No

IVL/ELCA

Stent if Necessary

Neointimal Hyperplasia

1:1 NC/Scoring/Cutting

1:1 NC/Scoring/Cutting

IVL/ELCA

Stent

Stent

Yes

Calcium Fracture Assessment via OCT

Brachytherapy for Recurrence

Neoatherosclerosis

Lipidic/Fibrotic

Calcific

Superficial

Nodular

CVI Score I-III

CVI Score IV

Balloon Crossable

Balloon Uncrossable

RA/OA/ELCA

IVL

No
OCT Assessment of ISR
Diagnose Underexpansion vs Neo-Intima

Due to CVI score 4 – calcium

Due to calcified nodule

Calcific Neoatherosclerosis
Clear Diagnosis of Underexpansion
When NC is not enough… use IVL!

1:1 NC Balloon

SHOCKWAVE
Evidence of stent expansion and peri-stent calcium fracture
Evidence of expansion

Pre MSA 1.09mm$^2$  Post MSA 6.47mm$^2$  Additional stent unnecessary: DCB
OCT is the gold standard in ISR assessment (and management!)

- Pretreatment essential to prevent underexpansion… highlights importance “the first stenting procedure”

- Diagnosis of Underexpansion vs Neo-Intima crucial in strategic decision making for optimal outcome

- Both ELCA and IVL are possible therapeutic options for underexpansion

- Success of therapy can only be ascertained only via OCT measurement of MSA
CLI-OPCI I study provided guidance on clinical outcomes when OCT is used vs. angiography alone

CLI-OPCI I INCLUDED CONSECUTIVE PATIENTS UNDERGOING PCI WITH ANGIO ALONE (N=335) VS. PCI WITH OCT (N=335)\(^2\)

• OCT-guided PCI vs. Angio guided-PCI identified
  – additional procedural issues not recognized by angiography
  – adverse features requiring further intervention in 34.7% of subjects

• OCT-guided PCI may improve clinical outcomes, reducing the 1-year rate of cardiac death or MI

<table>
<thead>
<tr>
<th>EVENTS AT 1-YEAR FOLLOW-UP</th>
<th>ANGIOGRAPHIC GROUP (n=335)</th>
<th>OCT + ANGIOGRAPHIC GROUP (n=335)</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>23 (6.9%)</td>
<td>11 (3.3%)</td>
<td>0.035</td>
</tr>
<tr>
<td>Cardiac death</td>
<td>15 (4.5%)</td>
<td>4 (1.2%)</td>
<td>0.010</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>29 (8.7%)</td>
<td>18 (5.4%)</td>
<td>0.096</td>
</tr>
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</table>
CLI-OPCI II: Independent predictors of MACE were in-stent MLA <4.5mm², distal edge dissection, distal reference narrowing, and proximal reference narrowing.¹

1. Prati et al Clinical Impact of OCT-Guided PCI, JACC: Cardiovascular Imaging, Vol. 8, No. 11, 2015, November 2015:1297-305
Using a novel stent sizing protocol, OCT-guided PCI will be non-inferior to IVUS-guided PCI and superior to angiography-guided PCI in achieving acute post-PCI MSA.

Ali, Lancet ‘16
Inclusion:
- Single native vessel
- One or more target lesions
- RVD 2.25mm - 3.50mm
- Length < 40mm

Exclusion:
- Left main
- Ostial RCA
- CTO
- Planned bifurcation
- eGFR < 30ml/min

Protocol

Pre-PCI OCT
- OCT Stent Sizing Guidance, per study protocol
- OCT guided Optimization per study protocol
- Post-PCI OCT

Pre-PCI IVUS
- IVUS guided PCI, per "local standard practice"
- IVUS guided optimization, per "local standard practice"
- Post-PCI OCT, blinded to investigator

Angiography
- Angiography guided PCI, per "local standard practice"
- Angiographic optimization, per "local standard practice"
- Post-PCI OCT, blinded to investigator

Identification of study lesion

Randomization to OCT-, IVUS- or angiography-guided PCI

Procedure Complete

Ali, Lancet '16
• OCT-guided PCI using a specific EEL-based stent optimization strategy was non-inferior to IVUS-guided PCI for achieving MSA.

• OCT-guided PCI resulted in superior stent expansion and procedural success compared to angiography-guided PCI.

• OCT-guided PCI resulted in the fewest untreated major dissections and areas of major stent malapposition.

Ali, Lancet ‘16
OCT for optimization of coronary interventions: why, how and when?

- We have robust data showing how OCT is safe and better than angio in assessing lesion morphology and final PCI result.
- OCT should be used, if available, in any complex coronary case.
- Though direct reimbursement for the OCT is often not available, this should not be used as an excuse for its penetration in Your own cath lab!