Real-Time IVUS Guidance For PCI In Calcified Lesions

Assoc. Prof. Huynh Van Thuong, MD, PhD
Khánh Hòa General Hospital

SCAI Expert Consensus Algorithm for Calcified Lesion Management

A Standardized 5-Step Workflow to Optimize PCI Outcomes

- **Step 1: Identification (Angiographic Assessment)**
- **Step 2: Intravascular Imaging**

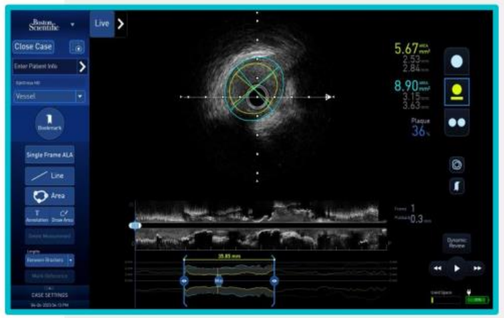
  IVUS AI (AVVIGO+ with ALA™)
- **Step 3: Lesion Modification (Device Selection)**

  NC, OPN Balloon, Scoreflex, cutting Balloon, IVL, Rota, Orbital, Laser
- **Step 4: Confirmation of Modification (Fracture Verification)- IVUS AI**
- **Step 5: Stent Optimization (MSA & Apposition)- IVUS AI**

AVVIGO™+
Multi-Modality Guidance System

Key Features

Boston Scientific
Advancing science for life™



Automated Lesion Assessment (ALA™)

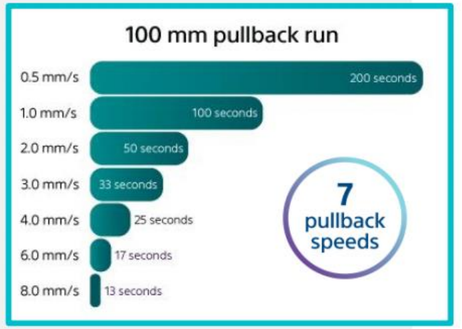
Precise Vessel Measurements

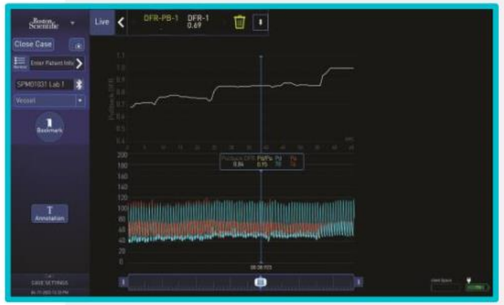
- Accurate lumen and vessel borders
- Vessel profile
- Key frame markers

Fast Pullback

High quality images at the pullback speed you want

Automatic pullback now includes faster speeds up to 8 mm/s allowing for quicker vessel imaging





PhysioMap™

Enhanced DFR guidance

Optimize your treatment decisions by quickly locating regions of pressure change during a pullback

Tableside Control

Complete control from the sterile field

Operate IVUS and capture physiological measurements on your integrated system without leaving the sterile field

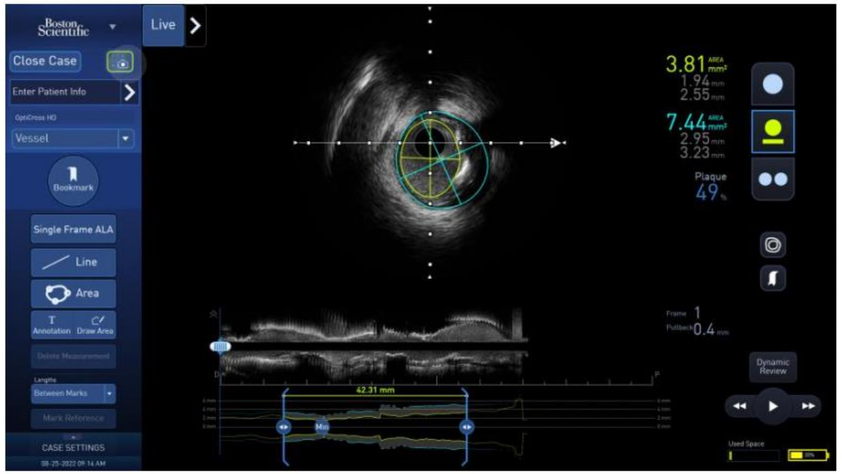
*Fast pullback includes 0.5, 1, 2, 3, 4, 6, or 8 mm/s
*DFR or Diastolic hyperemia free ratio is a type of hyperemia free physiologic index
*Tableside Control is available on integrated systems only

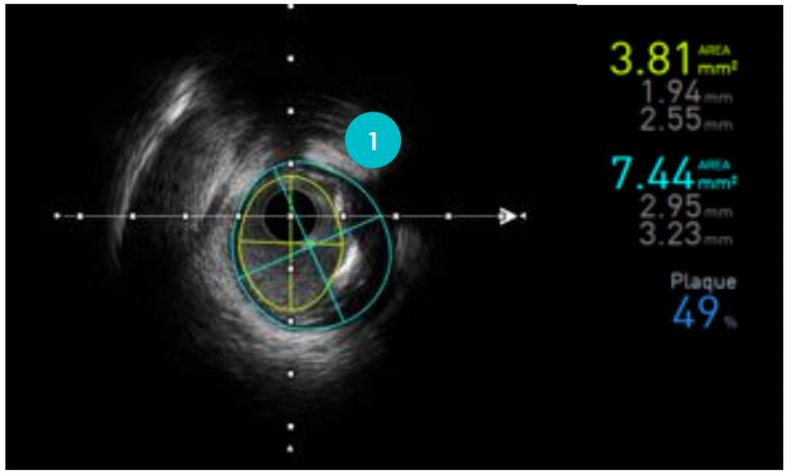
AVVIGO™+
Multi-Modality Guidance System

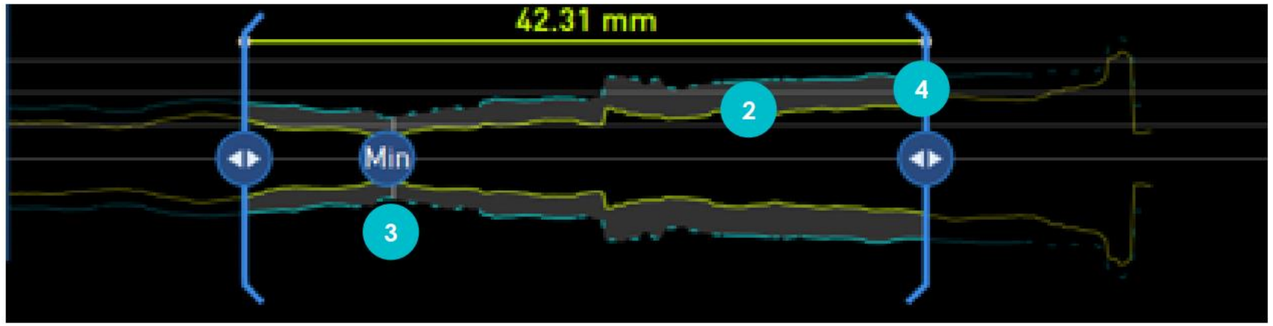
ALA™
Automated Lesion Assessment

Boston Scientific
Advancing science for life™

Automated Lesion Assessment leverages the power of machine learning to automatically deliver key measurements and borders, with a high degree of accuracy







1 Vessel and Lumen Borders

Vessel and lumen borders on every frame

Vessel area, lumen area and diameter measurements on every frame

2 Vessel Profile

Graphical representation of the average vessel and lumen diameters

3 Min Key Frame marker

Minimum lumen area in IVUS run

4 Distal & Proximal Key Frame markers

Proximal and distal key frame markers represented at 50% or less plaque burden from minimum frame

AVVIGO™+
Multi-Modality Guidance System

Agreement of Machine Learning and ALA

Boston Scientific
Advancing science for life™

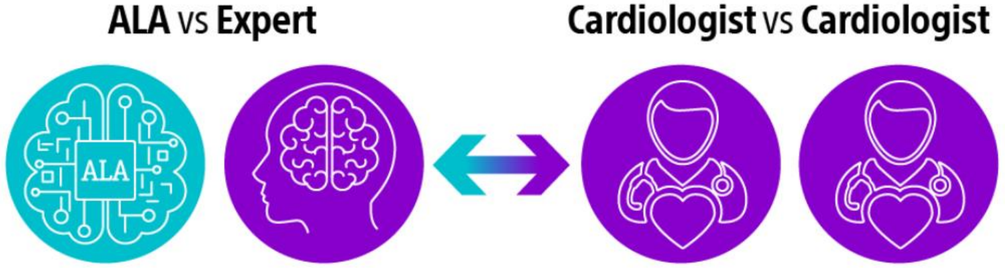
ALA was developed using 8,076 IVUS cross-sectional images from 234 patients

ALA performance was validated with an independent 437 IVUS cross-sectional images from 92 patients

ALA in clinical practice

Agreement between ALA and experts for balloon selection was 92.4 %

ALA Correlation



Measurements of lumen and vessel areas between ALA and an expert, and between two cardiologists had a similarly good intraclass correlation coefficient.

Correlation coefficients for lumen and vessel measurements

	ALA vs Expert	Cardiologist vs Cardiologist
Lumen area, mm^2	0.998	0.996
Vessel area, mm^2	0.993	0.996

IC-1568704-AA

Matsumura M, Mintz G, Dohi T, et al. ACCURACY OF IVUS-BASED MACHINE LEARNING SEGMENTATION FOR THE ASSESSMENT OF CORONARY ARTERY VESSEL AND LUMEN DIMENSIONS AND BALLOON SIZING. J Am Coll Cardiol. 2023 Mar, 81 (8_Supplement) 1353. https://doi.org/10.1016/S0735-1097(23)01797-7

AVVIGO™+
Multi-Modality Guidance System

Agreement of Machine Learning and ALA

Boston Scientific
Advancing science for life™

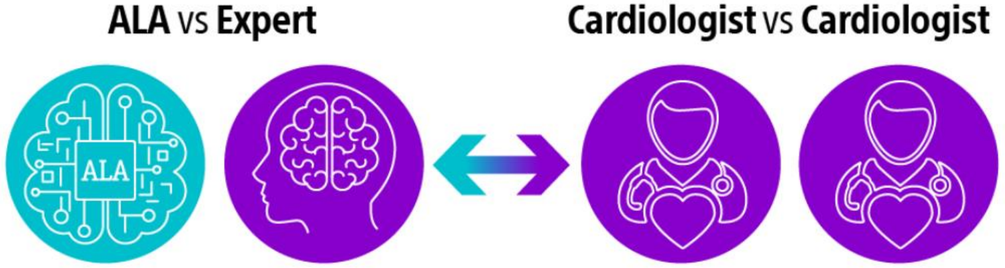
ALA was developed using 8,076 IVUS cross-sectional images from 234 patients

ALA performance was validated with an independent 437 IVUS cross-sectional images from 92 patients

ALA in clinical practice

Agreement between ALA and experts for balloon selection was 92.4 %

ALA Correlation



Measurements of lumen and vessel areas between ALA and an expert, and between two cardiologists had a similarly good intraclass correlation coefficient.

Correlation coefficients for lumen and vessel measurements

	ALA vs Expert	Cardiologist vs Cardiologist
Lumen area, mm^2	0.998	0.996
Vessel area, mm^2	0.993	0.996

IC-1568704-AA

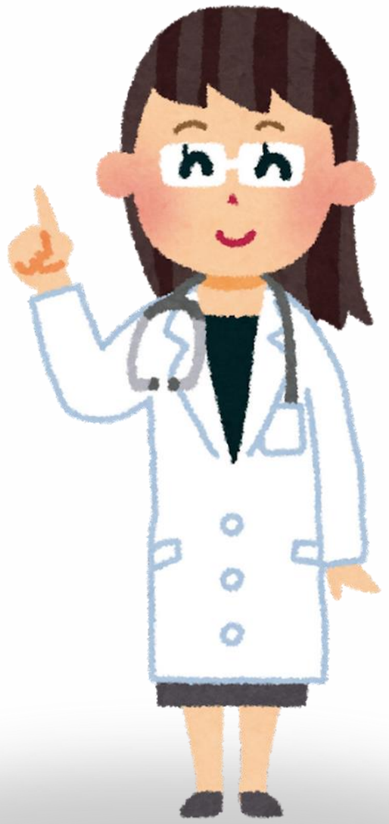
Matsumura M, Mintz G, Dohi T, et al. ACCURACY OF IVUS-BASED MACHINE LEARNING SEGMENTATION FOR THE ASSESSMENT OF CORONARY ARTERY VESSEL AND LUMEN DIMENSIONS AND BALLOON SIZING. J Am Coll Cardiol. 2023 Mar, 81 (8_Supplement) 1353. https://doi.org/10.1016/S0735-1097(23)01797-7

Major Advantages of AVVIGO IVUS System

1. AI-Powered Precision
2. Faster Procedure Times
3. Enhanced Imaging Quality
4. Integrated Physiology Tools
5. Tableside Control
6. Flexible Setup
7. Improved Patient Outcomes

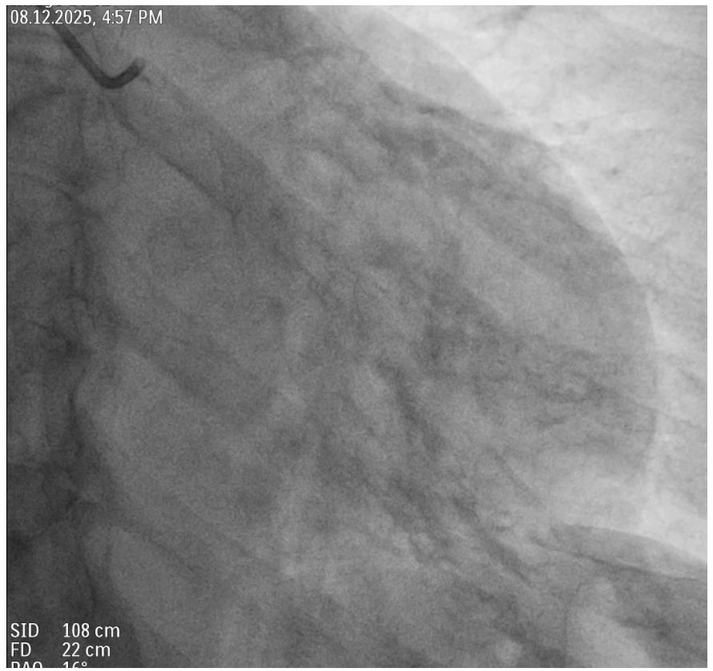
Clinical Case Presentation

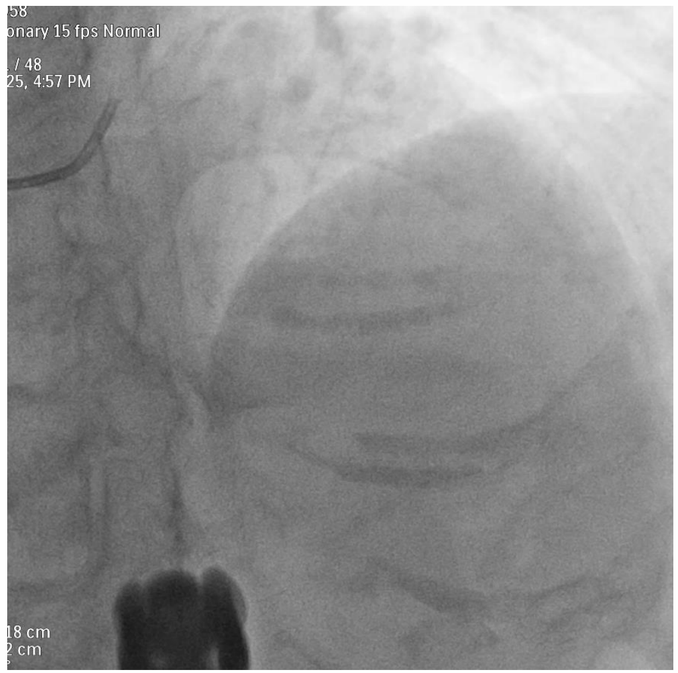
- **Clinical Presentation**
  - 59-year-old female
  - Left-sided chest pain
  - Dyspnea
- **Laboratory Findings**
  - hs-Troponin: 245 pg/mL
  - NT-proBNP: 2,400 pg/mL
- **Echocardiography**
  - Hypokinesia: anterior wall, apical region, lateral wall
  - LVEF: 30% (Simpson)

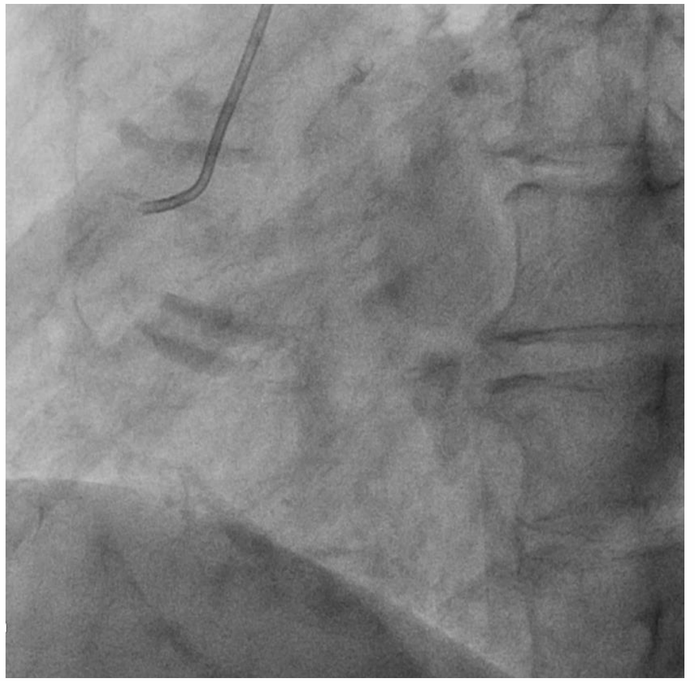


Step 1: Identification (Angiographic Assessment)

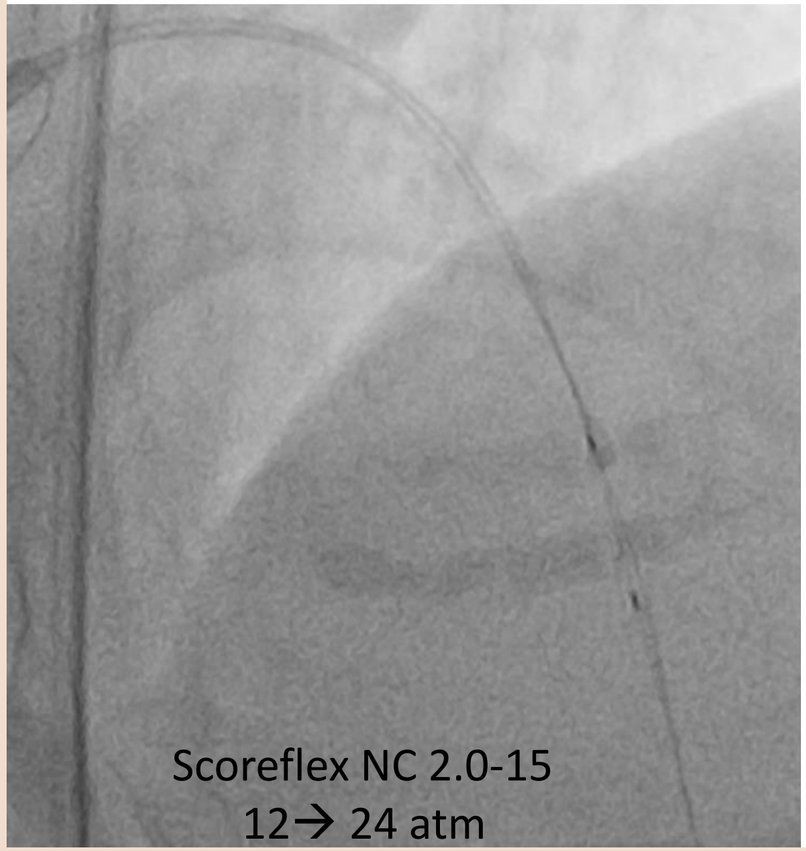
- Three-vessel coronary artery disease
- Severe coronary calcification

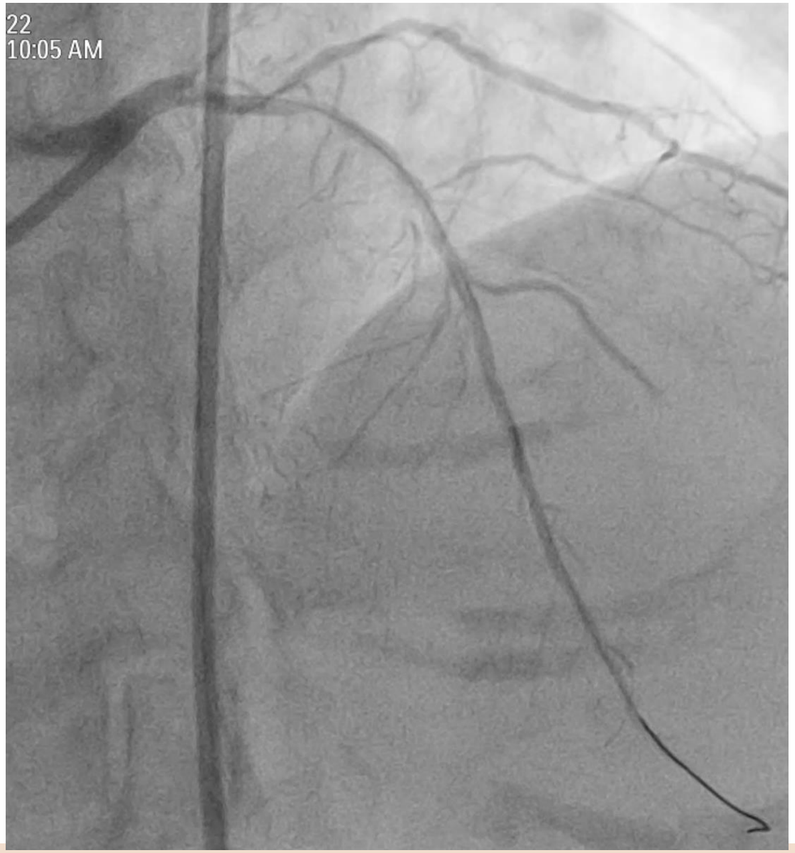


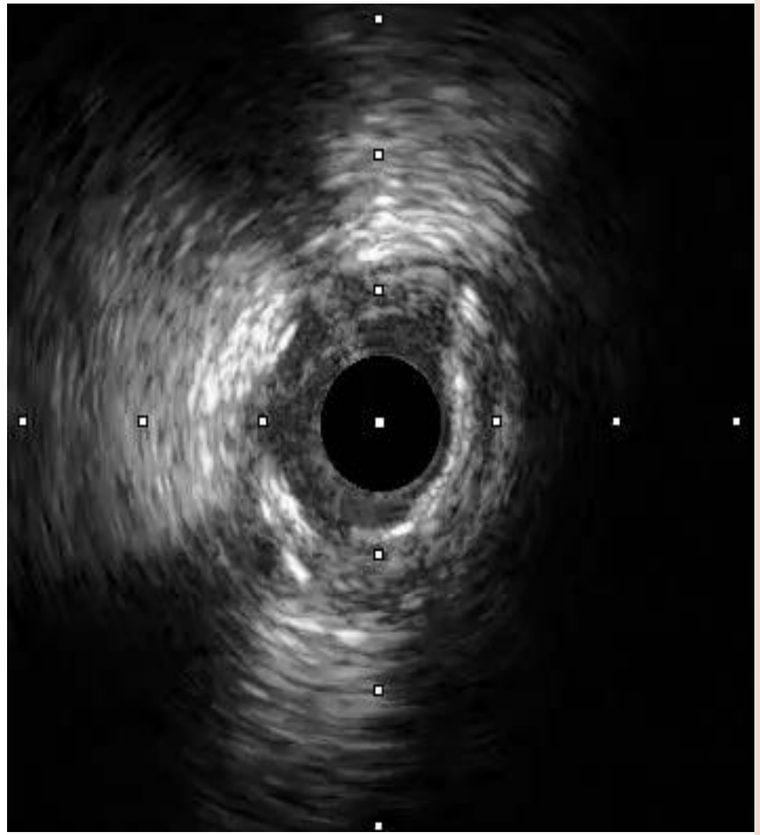




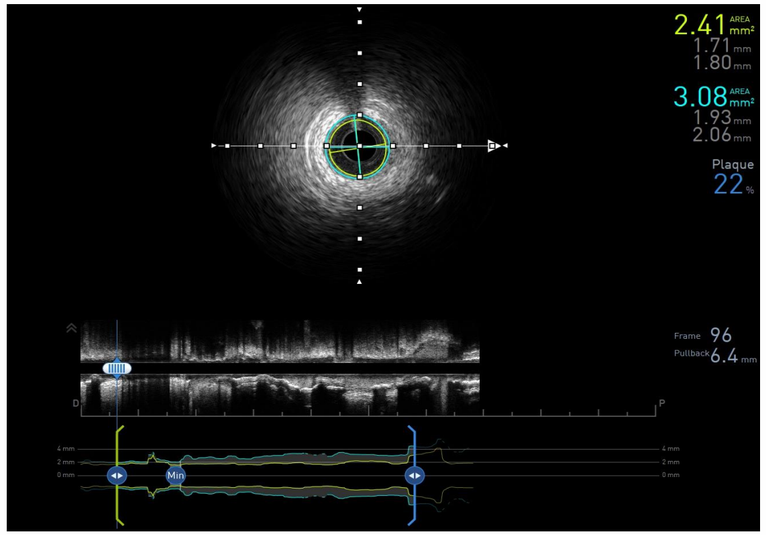
Lesion Preparation Before IVUS Imaging

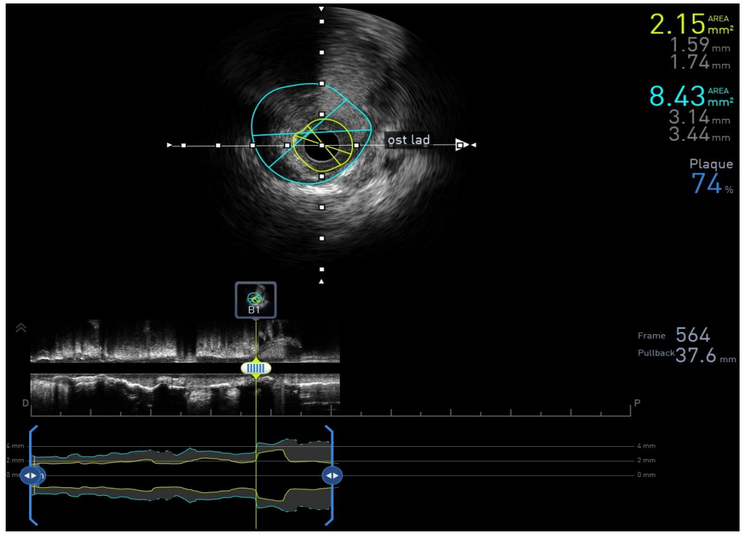


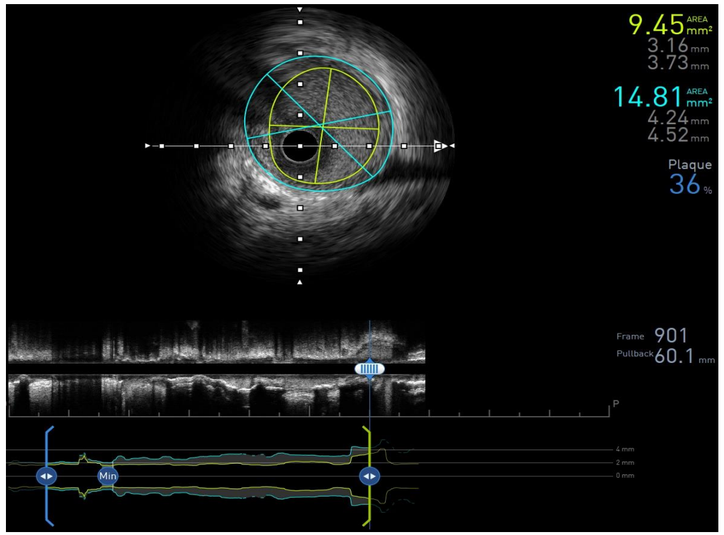


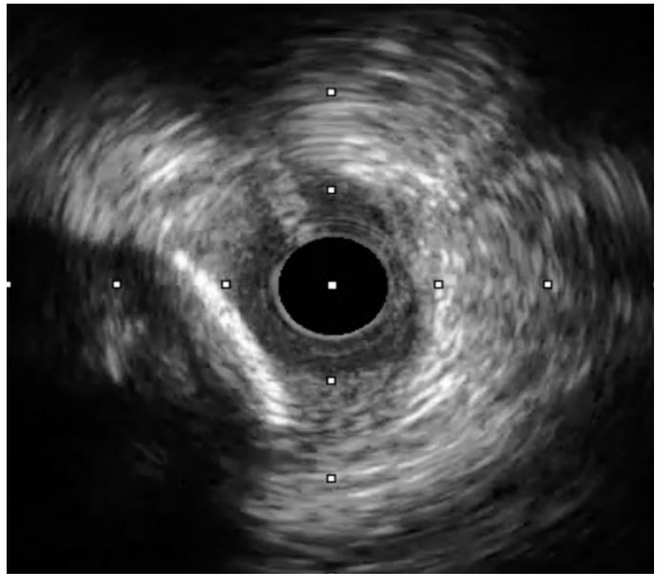


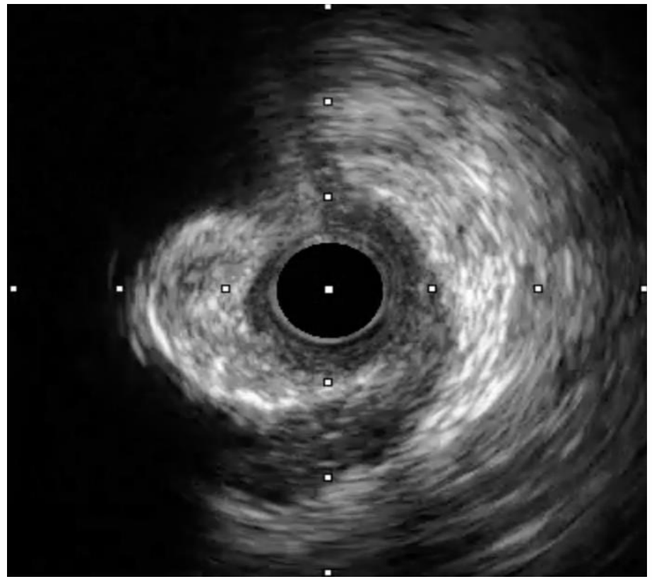
Step 2: Intravascular Imaging

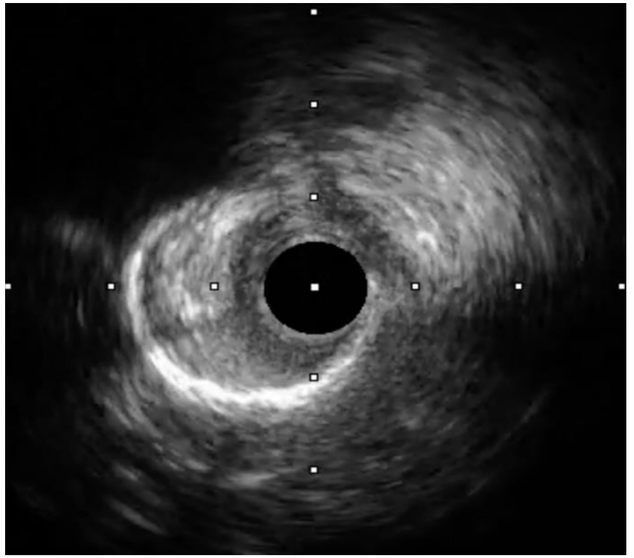












PCI Strategy

- Ostial LAD lesion; left main without significant stenosis
- LCX ostium preserved; distal LCX occluded

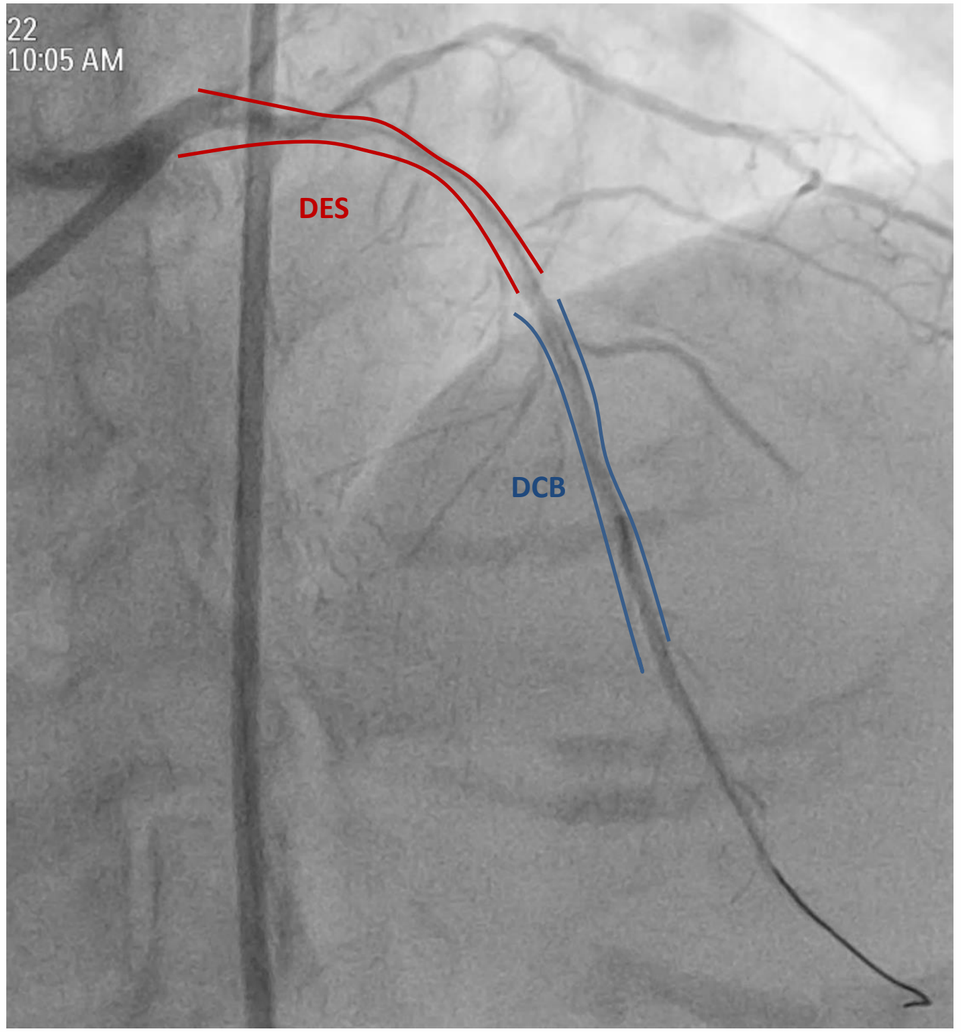
→ **Left main–to–LAD stenting strategy selected**

- Long LAD lesion with small distal vessel (2.0–2.2 mm)
- Severe ostial stenosis of the diagonal branch

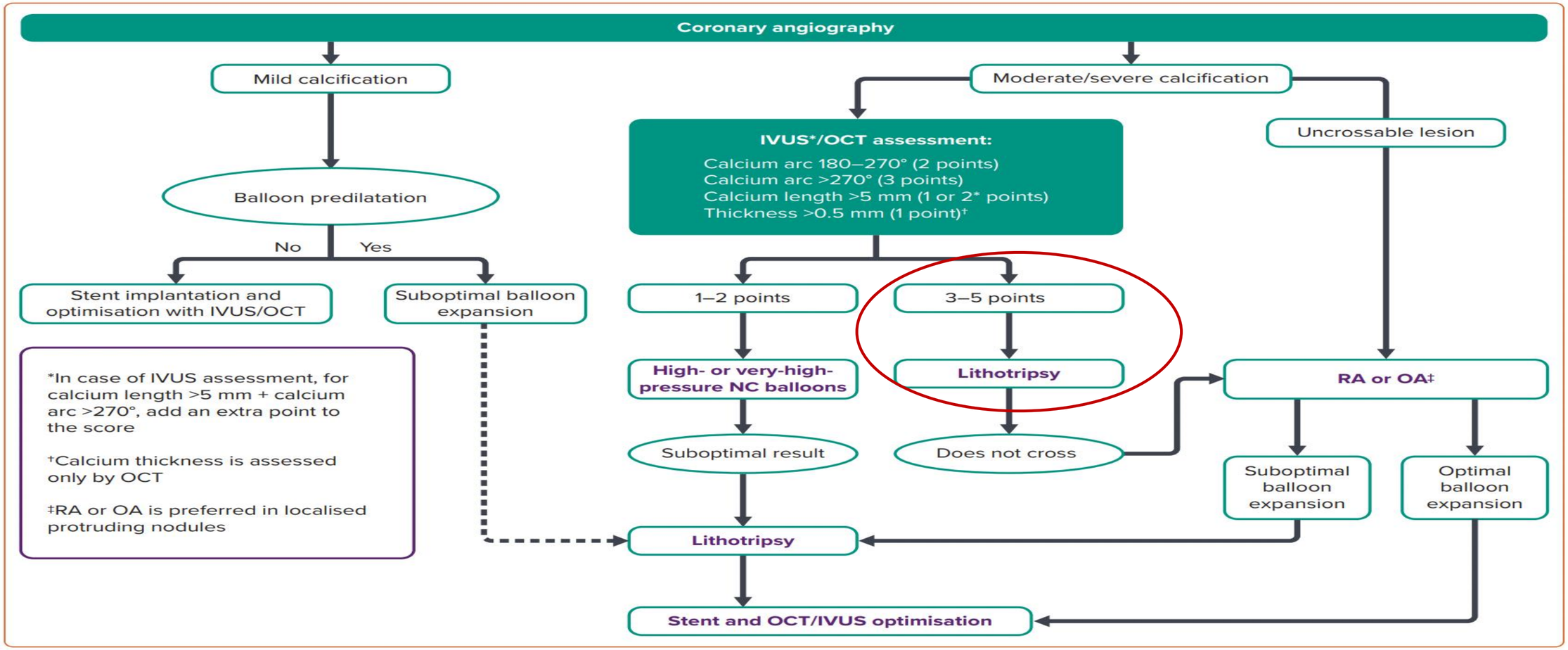
→ **Drug-coated balloon for the mid-LAD to avoid stenting in small vessels and to minimize side-branch compromise**

Bail-out strategy:

→ Stenting of the mid-LAD in case of severe dissection or significant residual stenosis

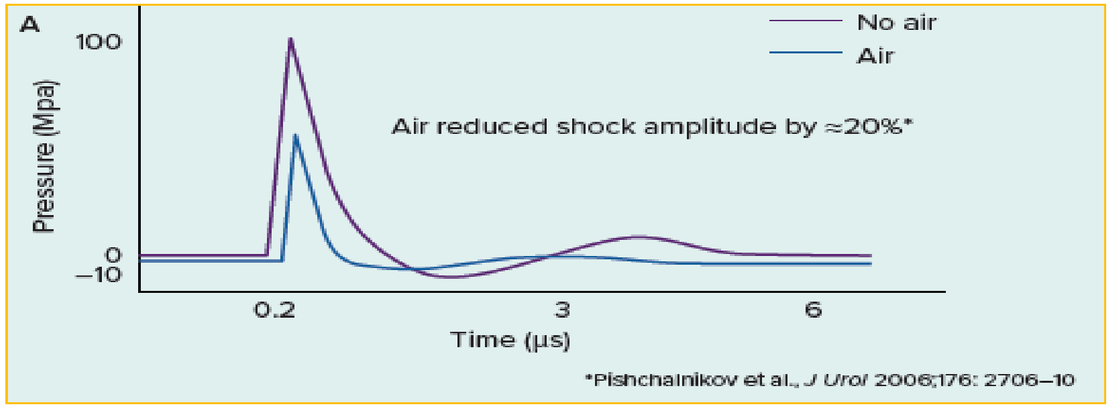


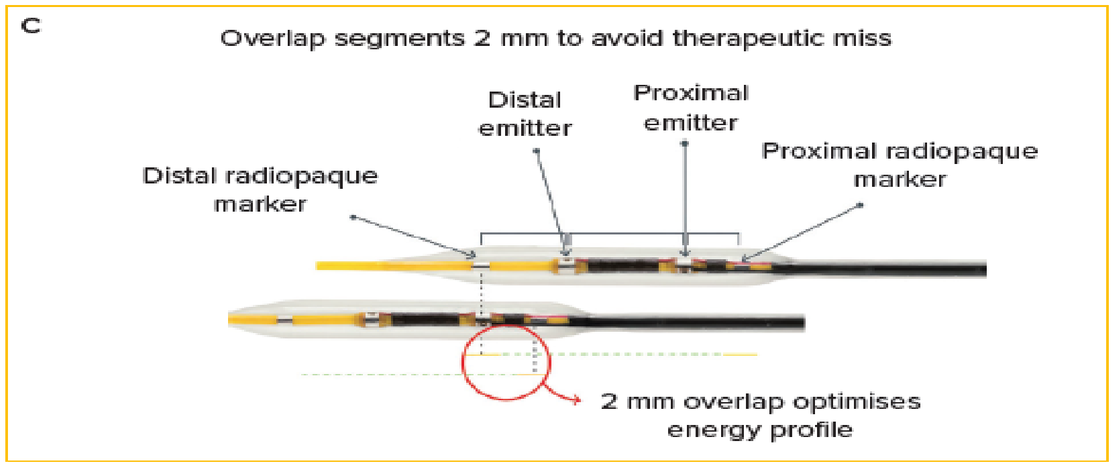
SCAI Expert Consensus Algorithm for Calcified Lesion Management

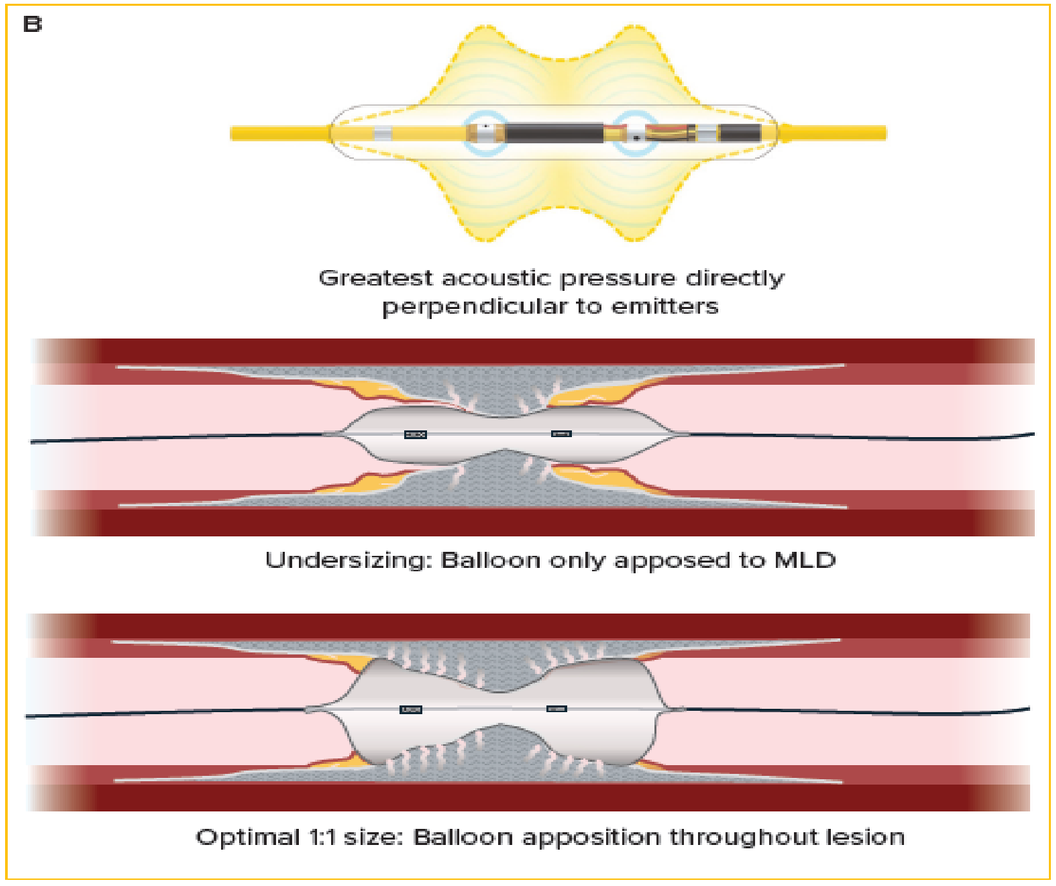


IVUS = intravascular ultrasound; NC = non-compliant; OA = orbital atherectomy; OCT = optical coherence tomography; RA = rotational atherectomy. Source: Sorini Dini et al. 2019.[19] Reproduced with permission from Radcliffe Cardiology.

SCAI Expert Consensus Algorithm for Calcified Lesion Management





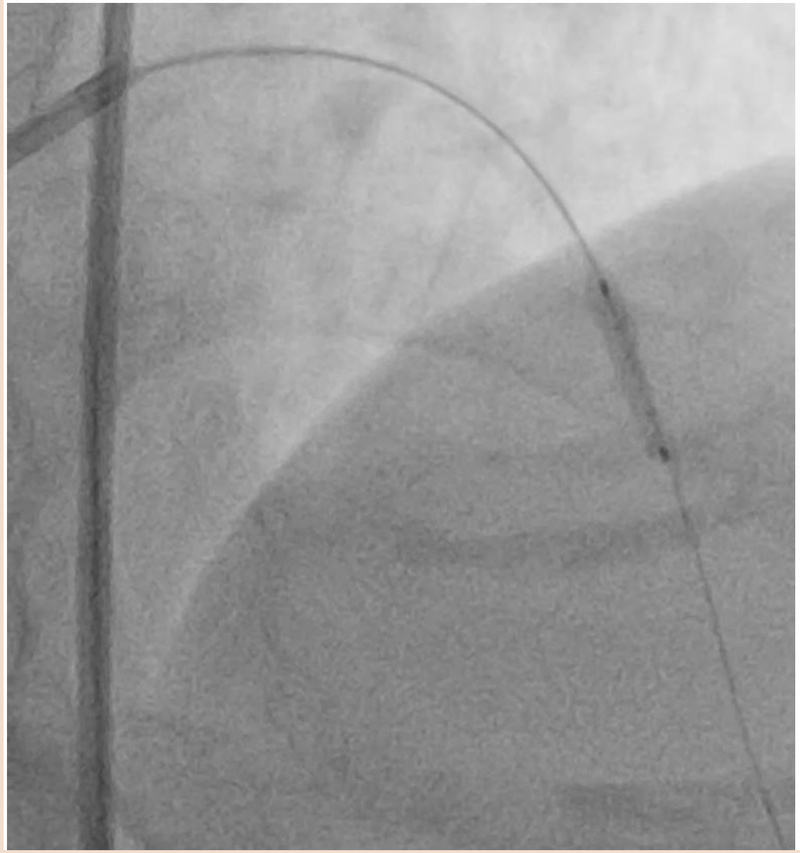


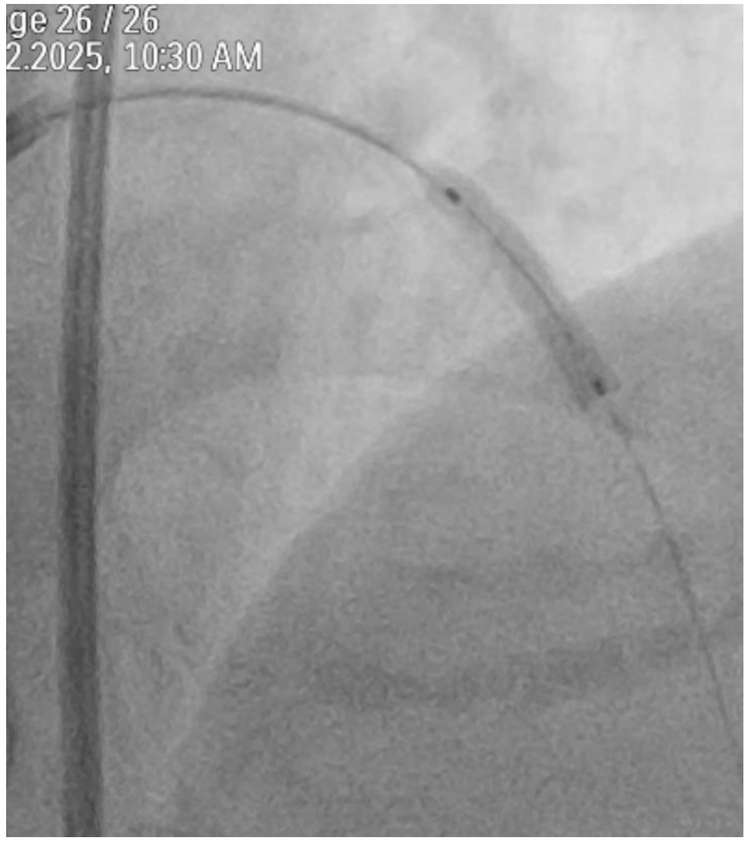
A: The presence of air at the ultrasound interface reduces shock amplitude by 20%. B: Undersizing balloons reduces efficacy of therapy delivery, thus limiting lesion preparation. The greatest acoustic pressure is perpendicular to the emitter position. C: Coronary shock wave intravascular lithotripsy balloon emitters are not equidistant from the radiopaque markers, with the proximal emitter being 2 mm away from the proximal marker, whereas the distal emitter is 4 mm away from the distal marker. This emphasises the importance of maintaining a 2 mm overlap between balloon positions to avoid therapeutic miss. Source: A: Adapted from Pishchalnikov et al.[8] Used with permission from Wolters Kluwer. B and C: Adapted from Shock Wave product literature. Used with permission from Shock Wave. MLD = minimal lumen diameter.

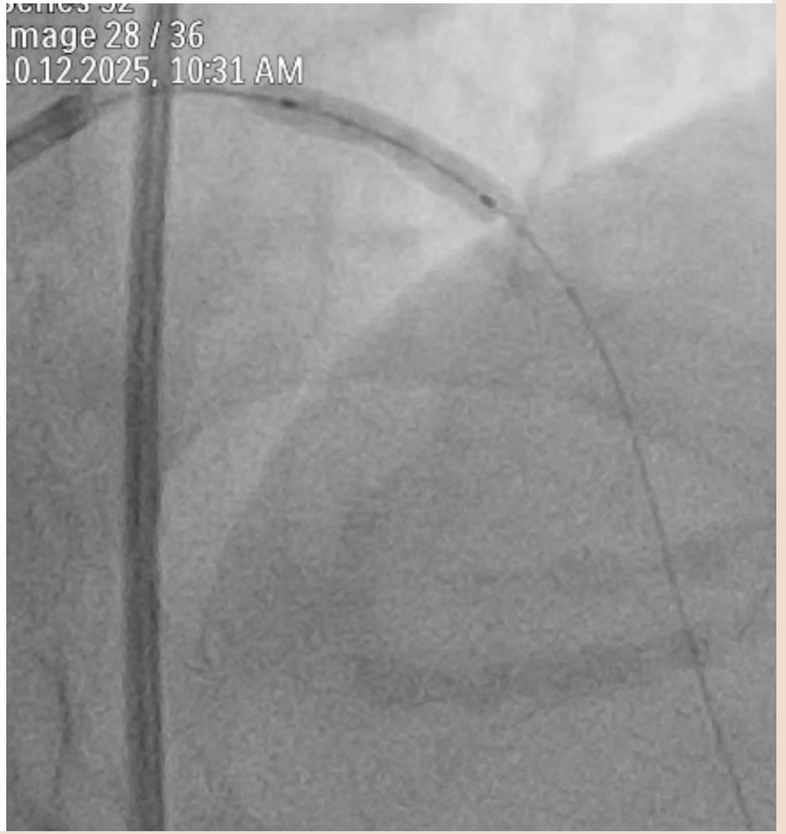
doi.org/10.15420/icr.2025.09

Step 3: Lesion Modification

- IVL balloon: 2.75 × 15 mm
- Treatment pressure: 6 atm
- Effectiveness assessment pressure: 12–20 atm
- Total IVL pulses: up to 120 cycles







Step 4: Confirmation of Calcium Modification

Indirect evidence:

•Complete expansion of a 1:1 sized balloon at low inflation pressure

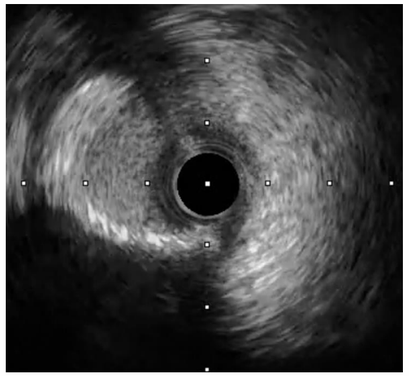
Direct evidence (IVUS):

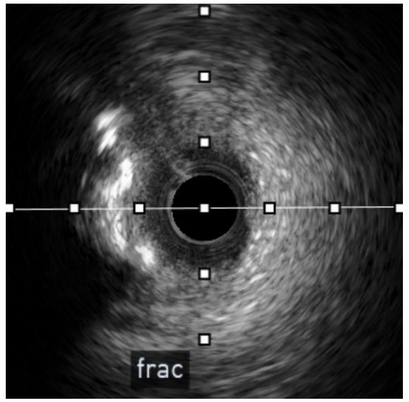
•Calcium fractures

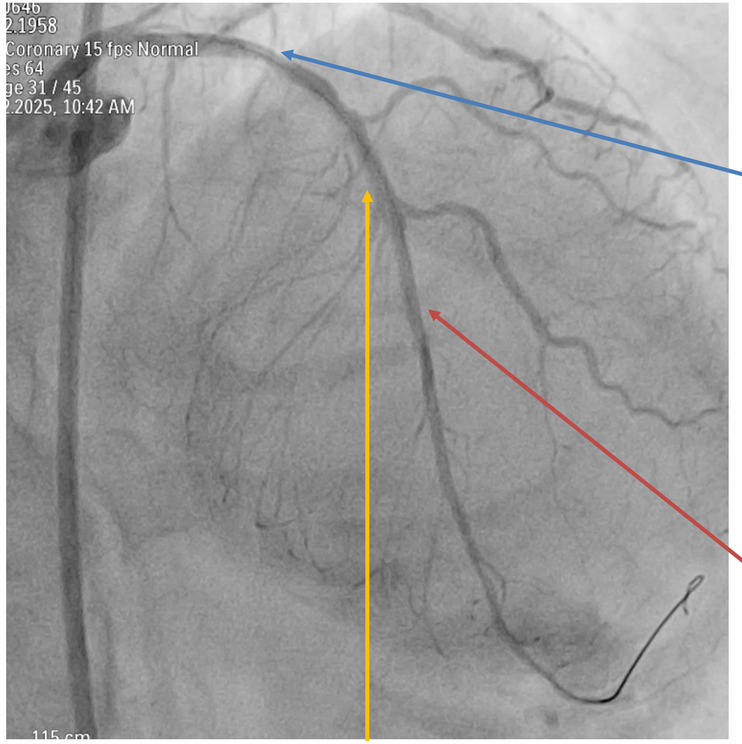
•Loss of acoustic shadowing

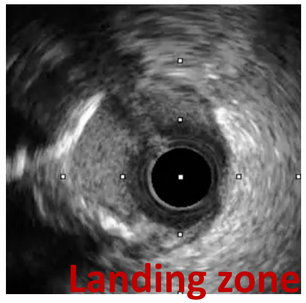
•Change in calcium morphology

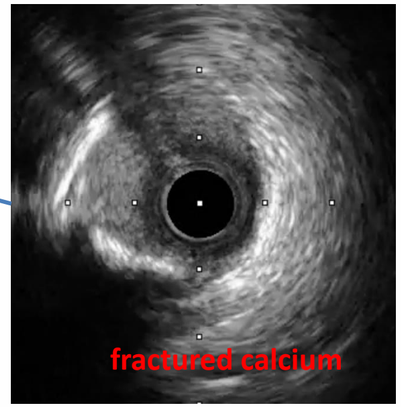
•Increase in lumen area

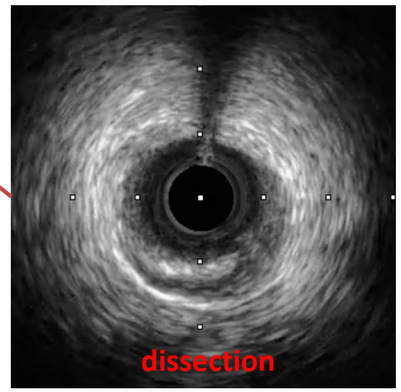


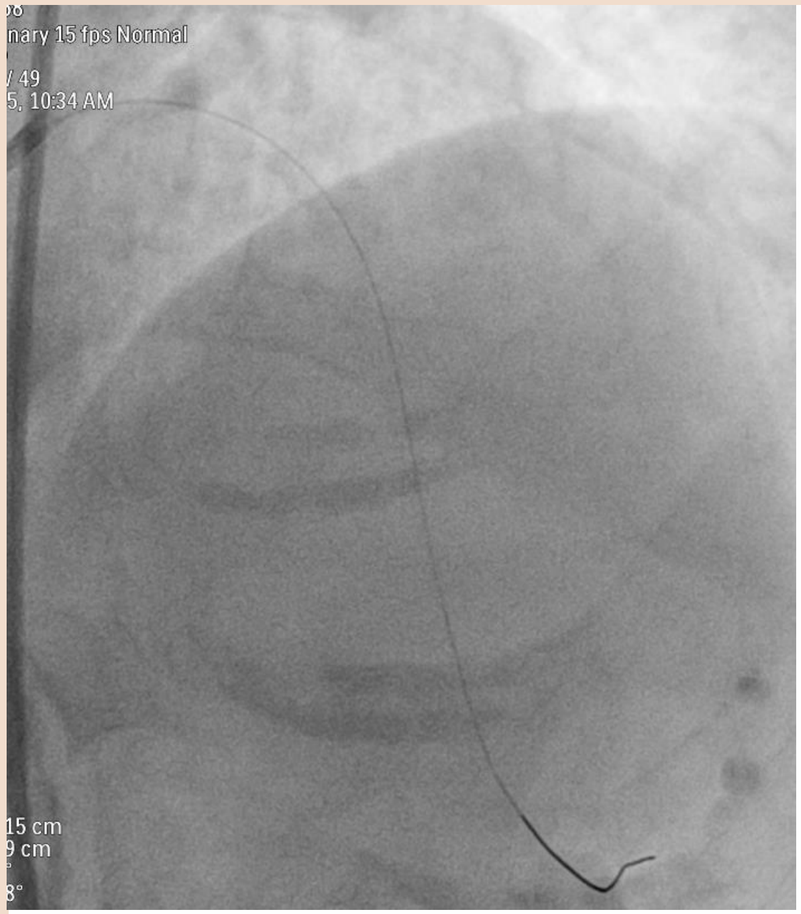




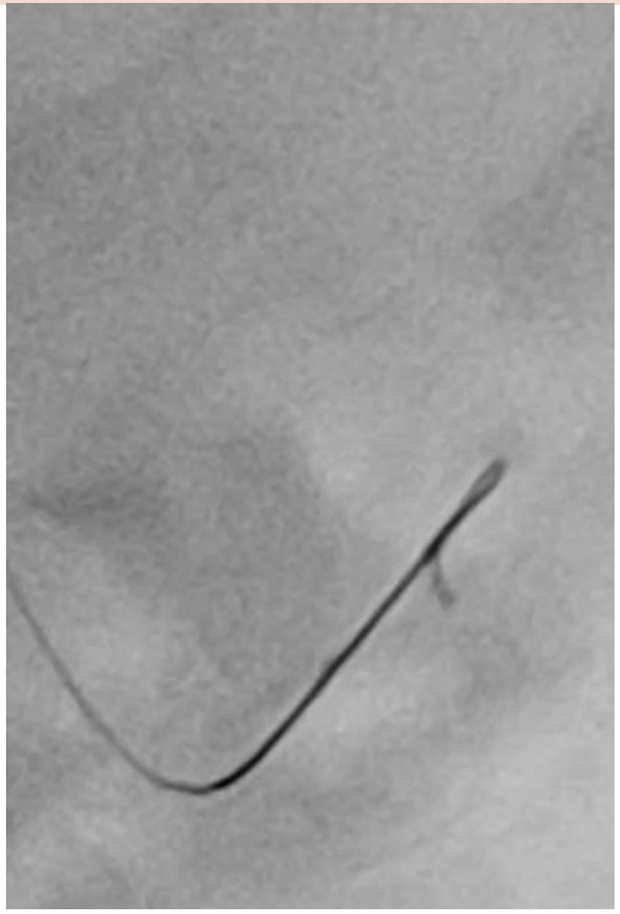




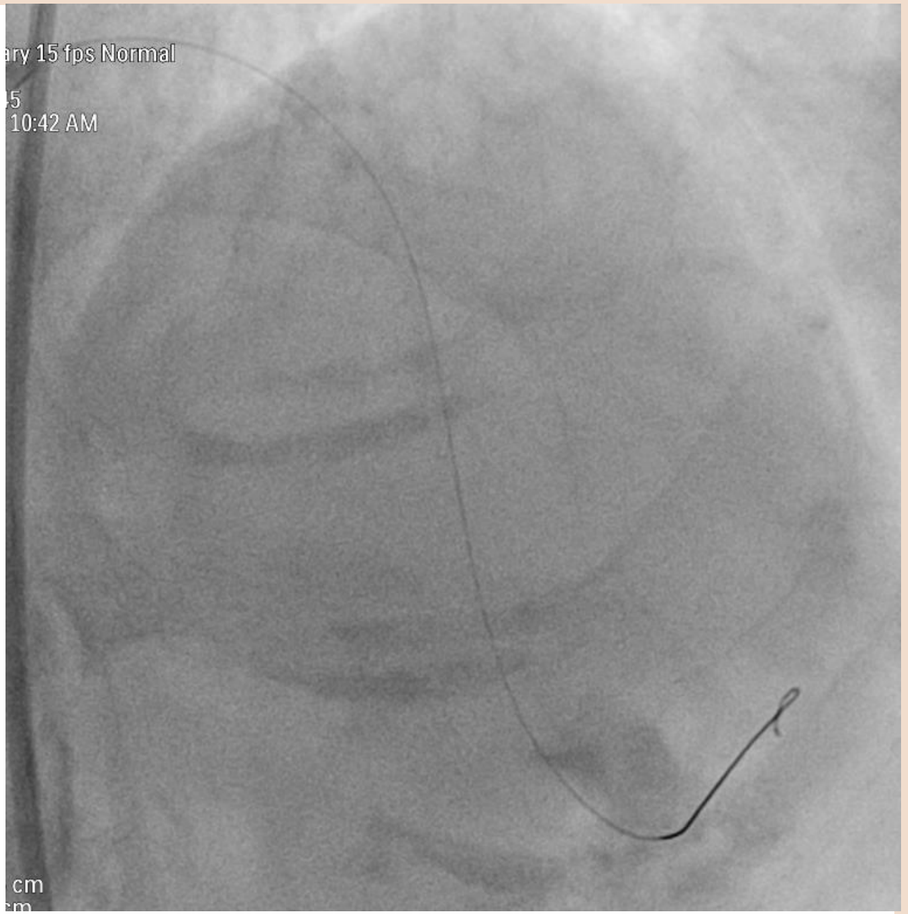




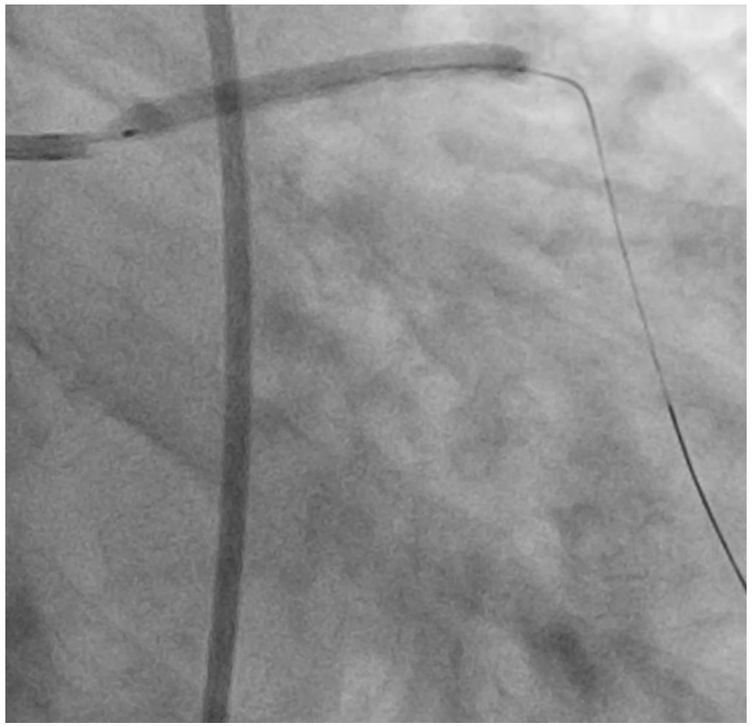
Prox LAD dissection with thrombus
Distal LAD perforation



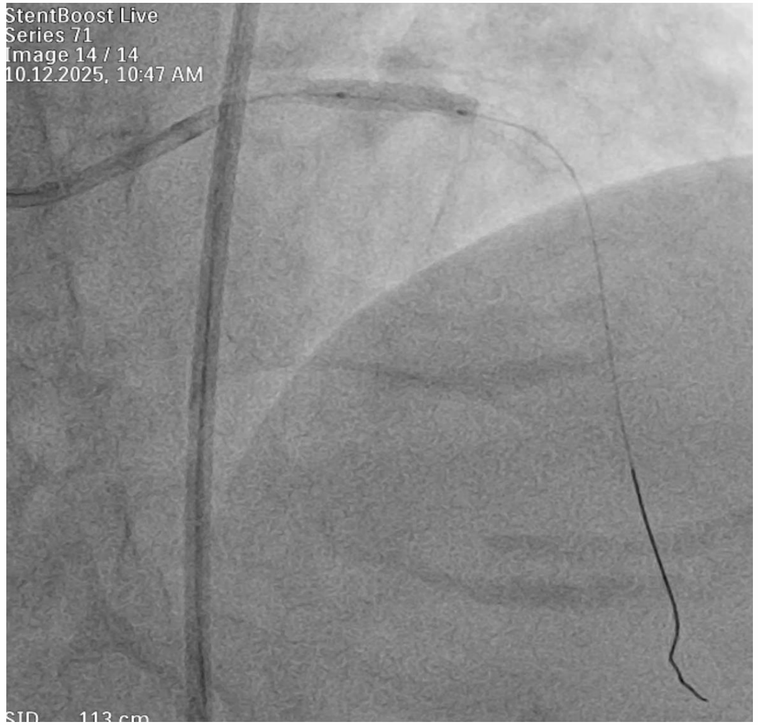
Spongel embolization via a Crusade catheter



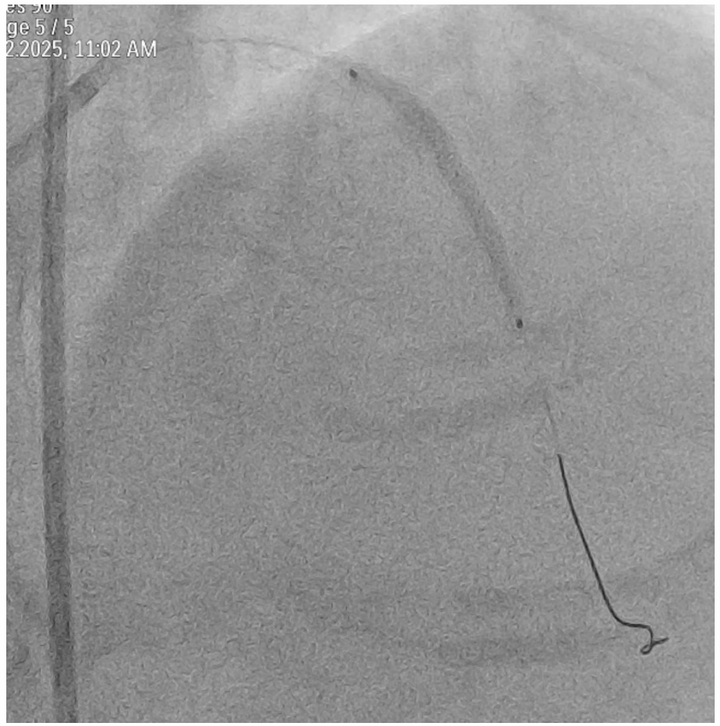
Result: complete sealing of the perforation site



DES 3.0 -36

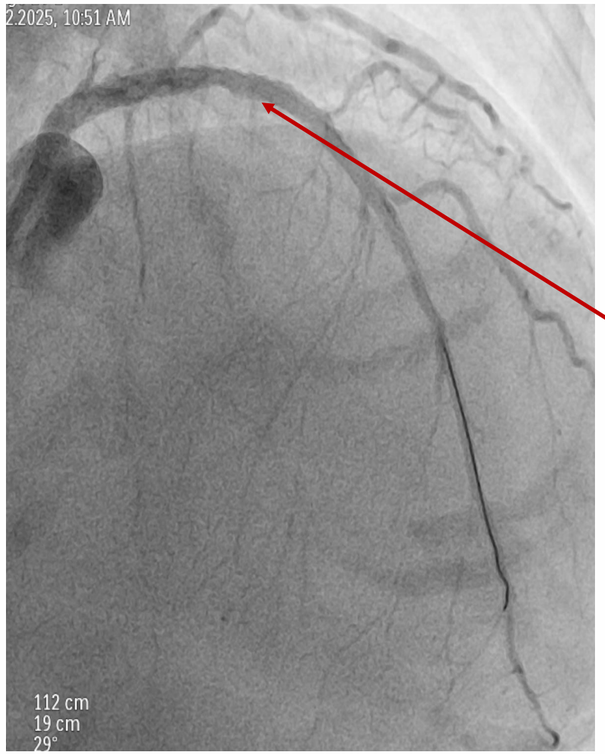


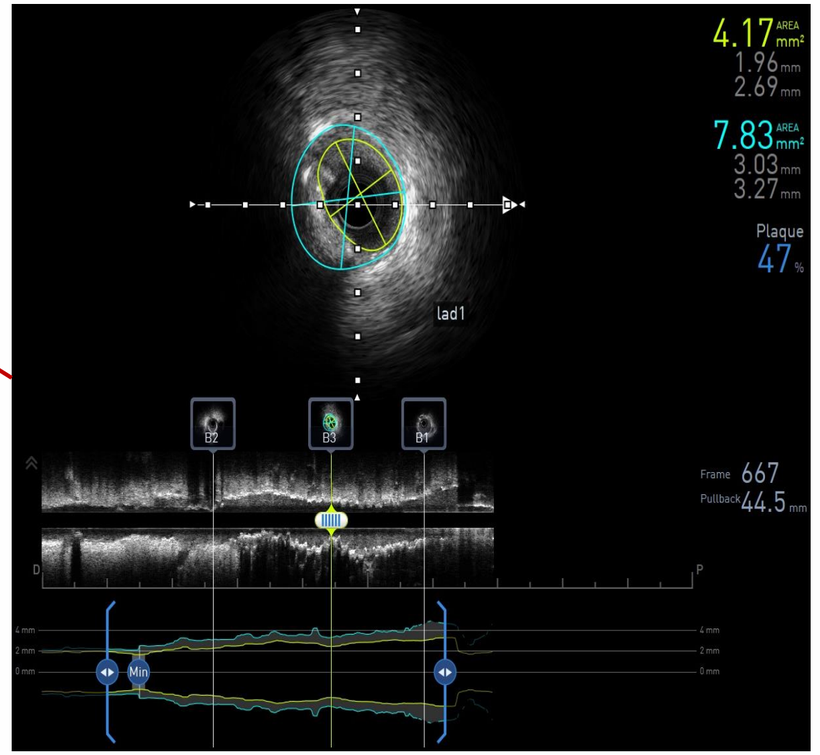
DES 3.0 -36

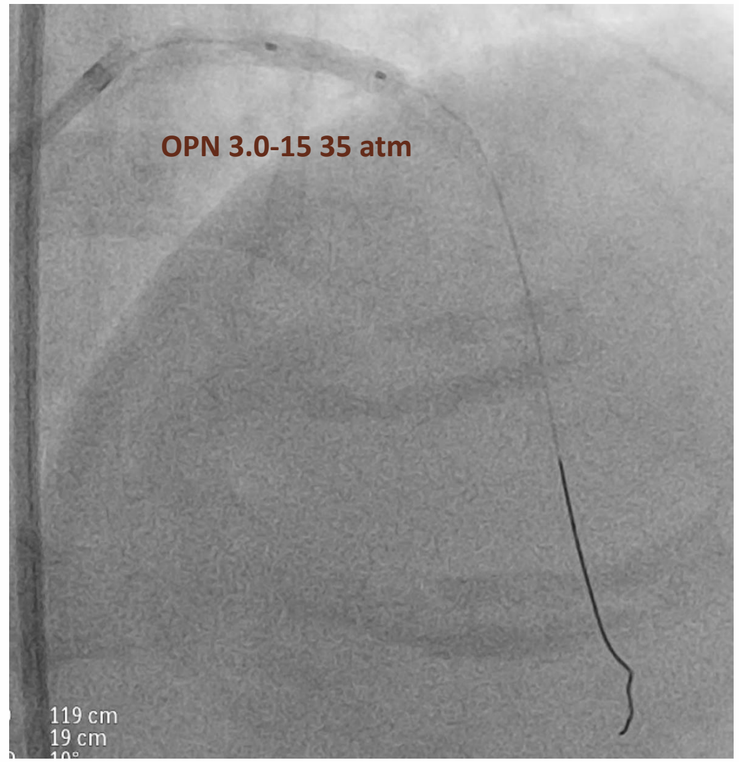


DCB 2.5-30

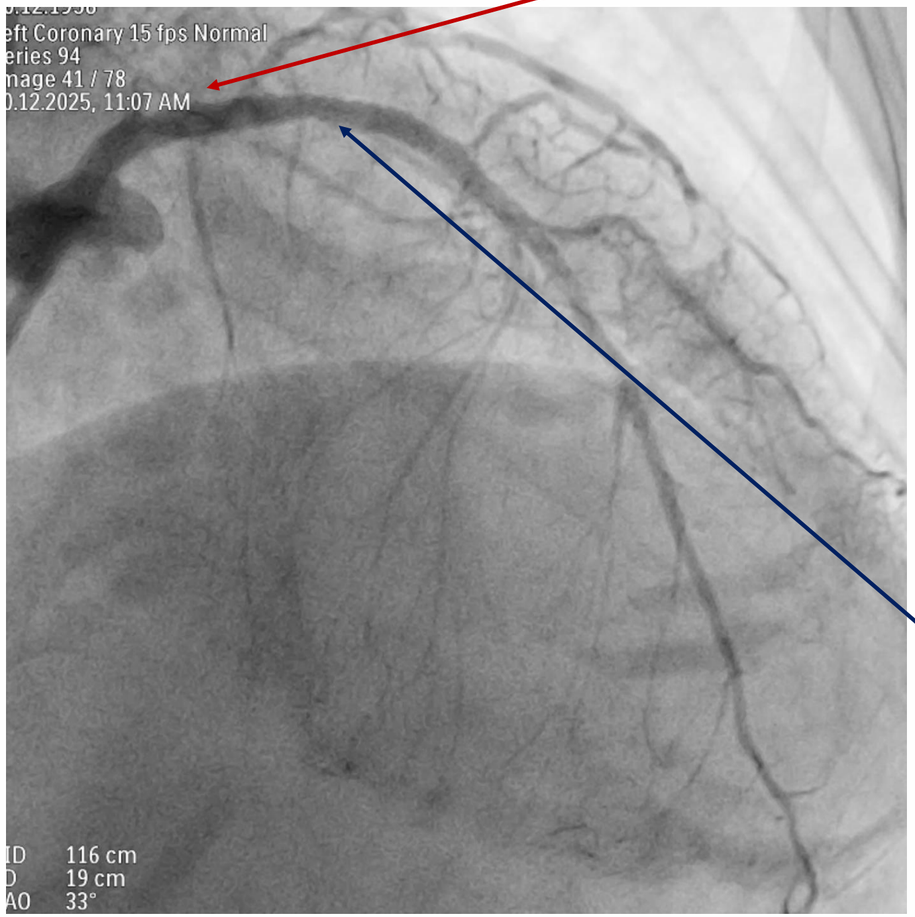
Step 5: Stent Optimization

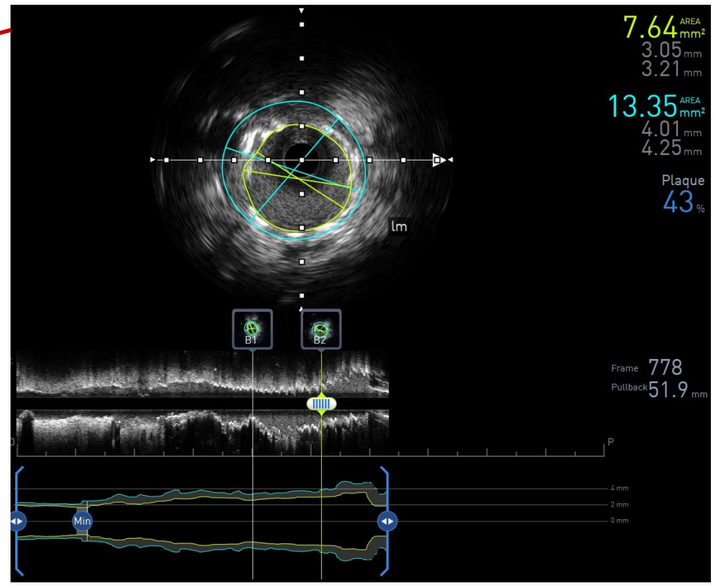


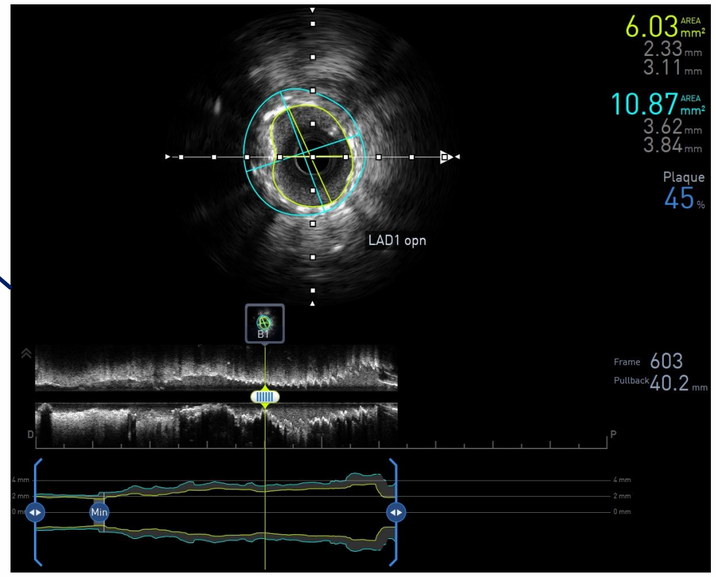




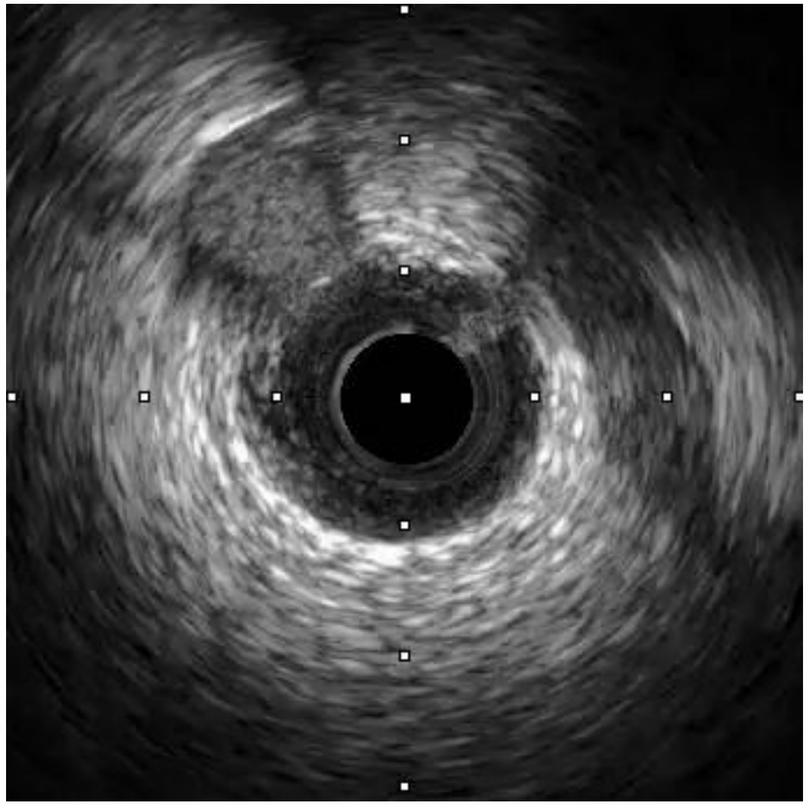
Step 5: Stent Optimization

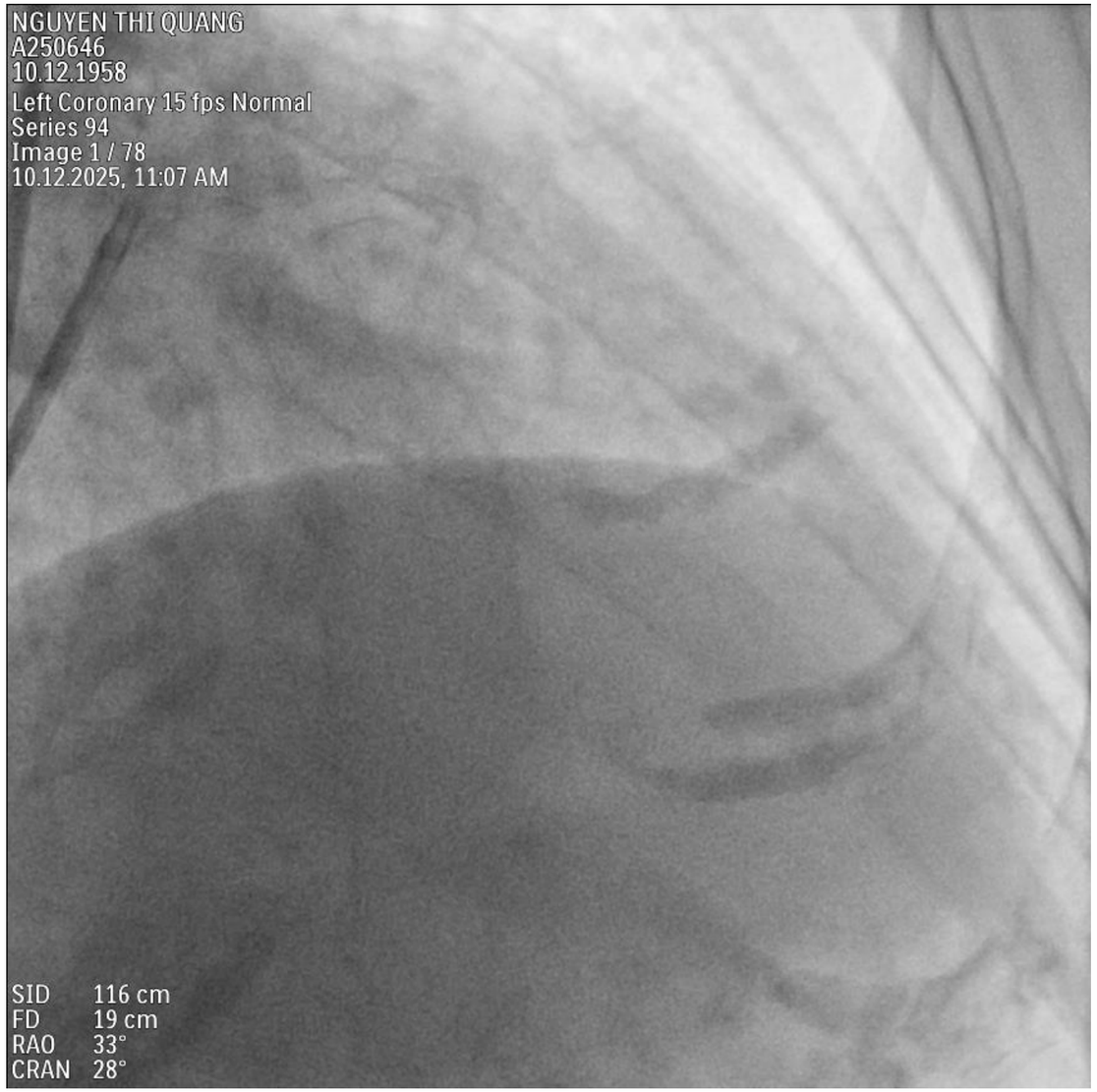






Final angiographic and IVUS result





IVUS Requirements in Complex High-Risk PCI

Procedural Complexity

- **High-risk patient**: low ejection fraction, severe three-vessel coronary artery disease
- **Complex lesions**: severe calcification with nodular calcium, diffuse disease
- **Prolonged procedure** with multiple procedural risks

During PCI:

- **Repeated IVUS examinations**
- Serial assessment of **lesion morphology** and **vessel dimensions**

→ **Technical requirements for IVUS:**

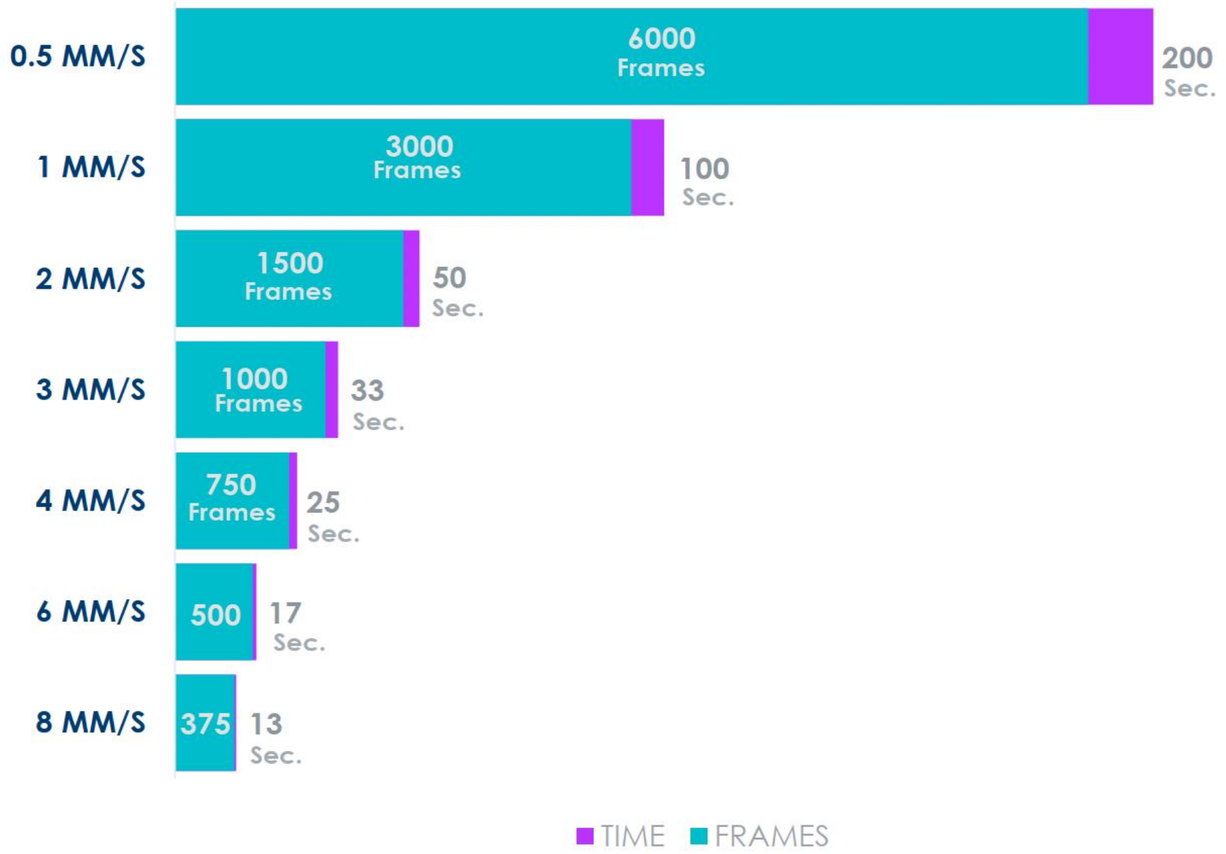
- Rapid and accurate analysis (ALA™)
- Short acquisition time for each pullback
- High-quality, clearly interpretable images

AVVIGO™+
Multi-Modality Guidance System

IVUS Fast Pullback

Boston Scientific
Advancing science for life™

FOR 100 MM AUTOMATIC PULLBACK



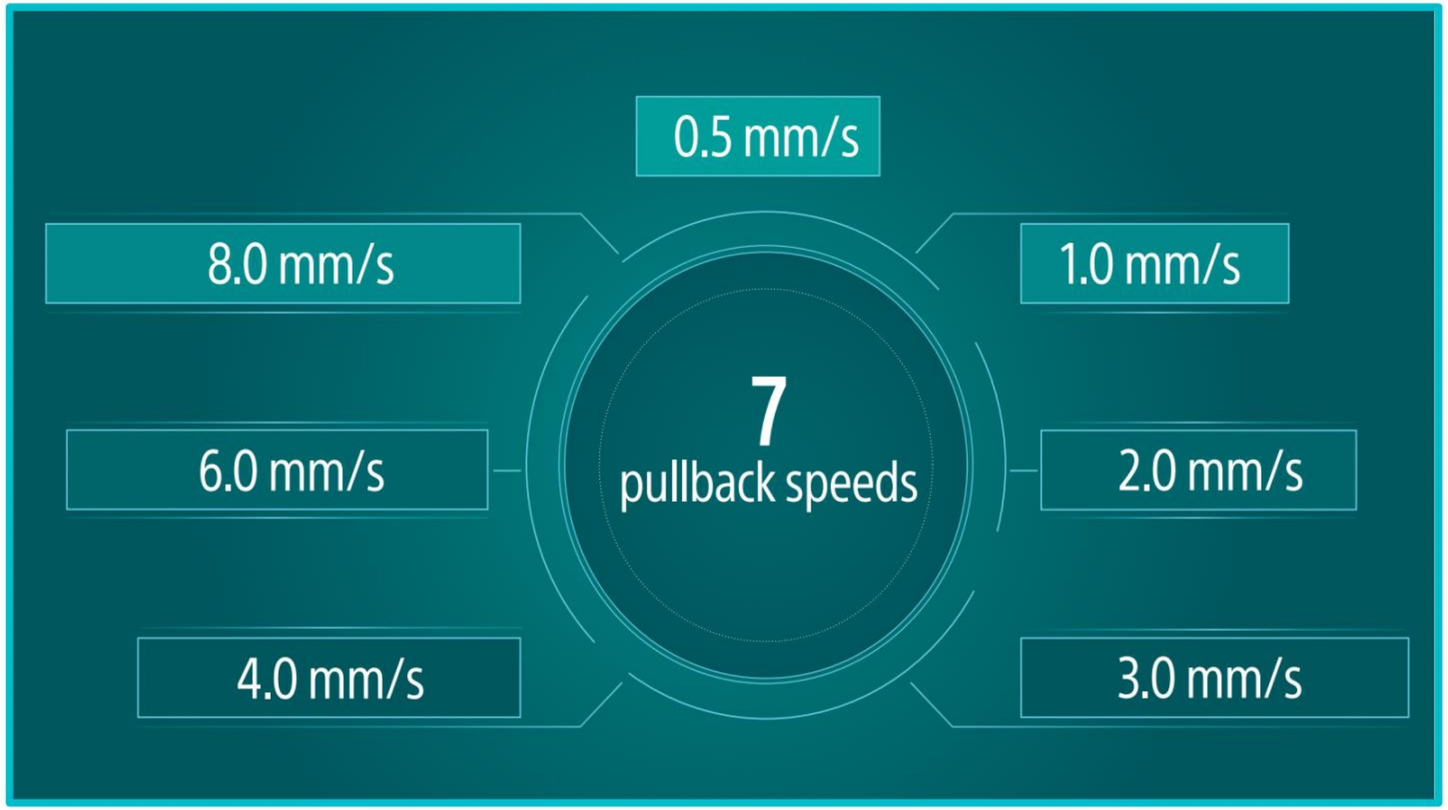
WHY AUTOMATIC PULLBACK?

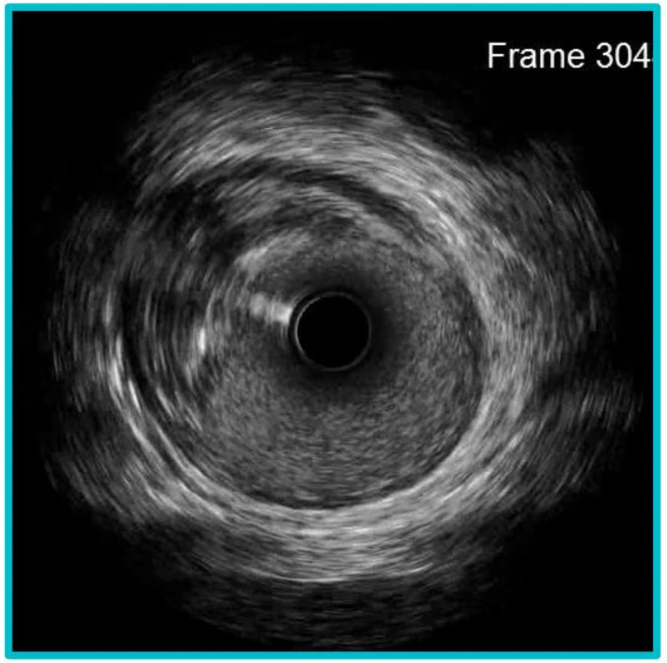
Manual pullback does not provide the longitudinal view of the vessel. Vessel profile view and lesion length related assessments cannot be done without longitudinal view.

AVVIGO™+
Multi-Modality Guidance System

Range of Pullback Speeds

Boston Scientific
Advancing science for life™





Experience same HD Image resolution for any speed
Frame rate: 30 frames per second

CONCLUSIONS

1. Imaging (coronary angiography and intracoronary imaging) is the foundation of modern PCI.

2. Intracoronary imaging enables:

- Accurate procedural planning
- Appropriate selection of lesion preparation strategies
- Reliable assessment of lesion preparation results

3. Intracoronary imaging facilitates precise decision-making between stent implantation, drug-coated balloon therapy, or a hybrid approach.

4. Next-generation IVUS platforms (AVVIGO) help shorten procedural time while improving the accuracy and safety of PCI

Thank you for your attention