

Complex high-risk Interventional Procedure

Role of Imaging Devices for Complex PCI

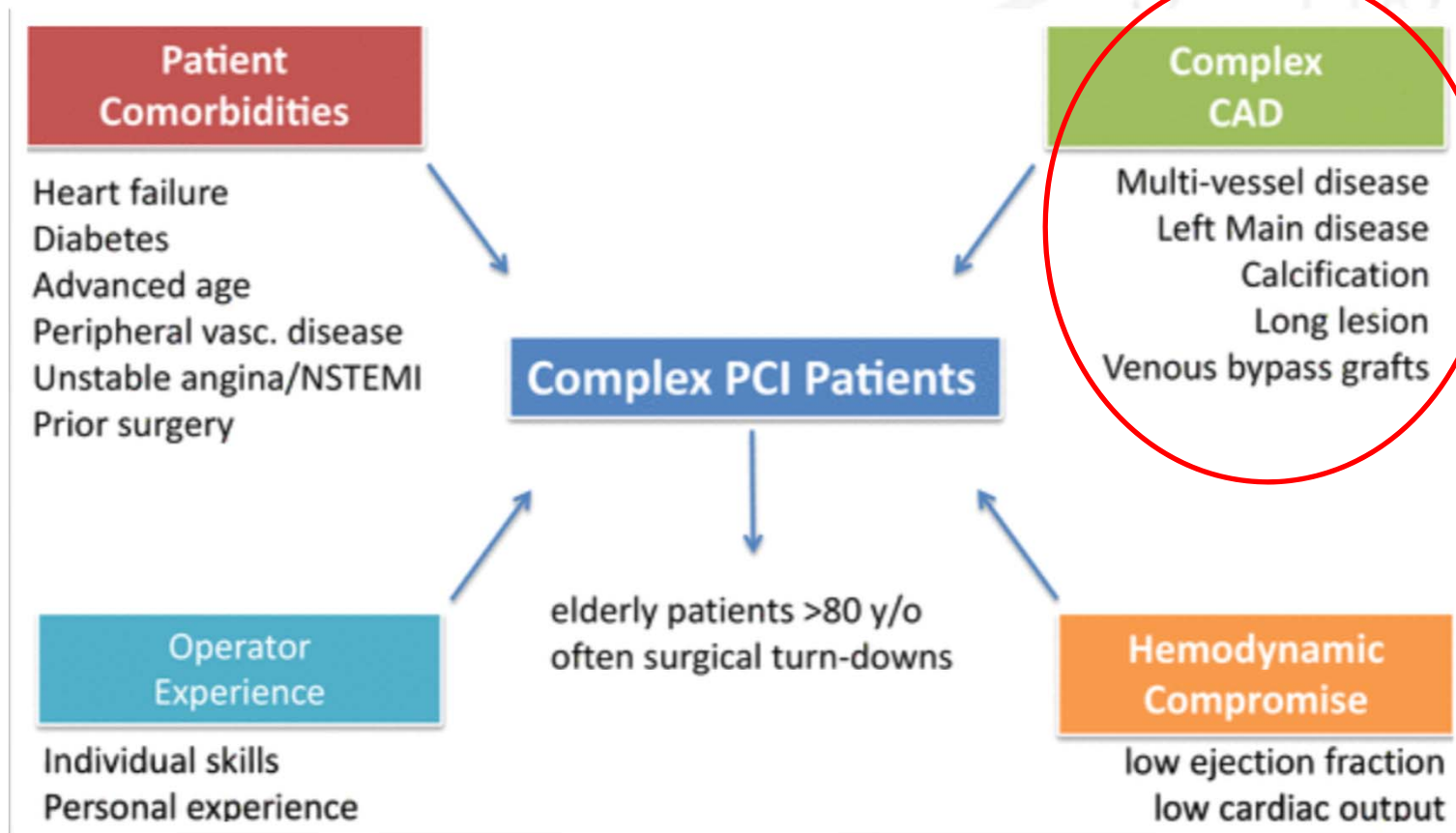
~ Case-based ~



Joint meeting of
Cardiovascular Intervention and
Revascularization **2019**

Seung-Ho Hur, MD, PhD, FACC
Keimyung University Dongsan Hospital
Daegu, Republic of Korea

Complex PCI



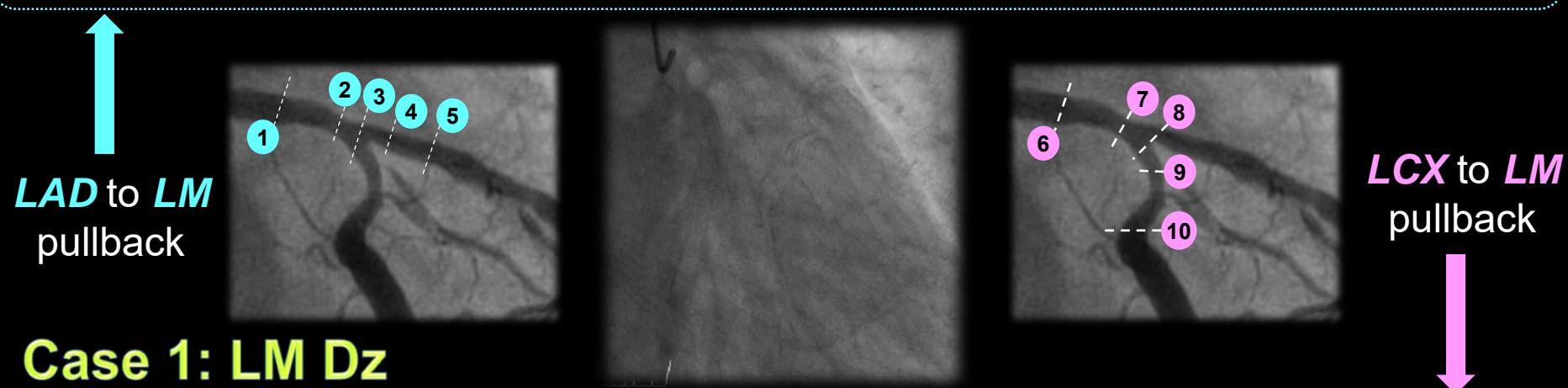
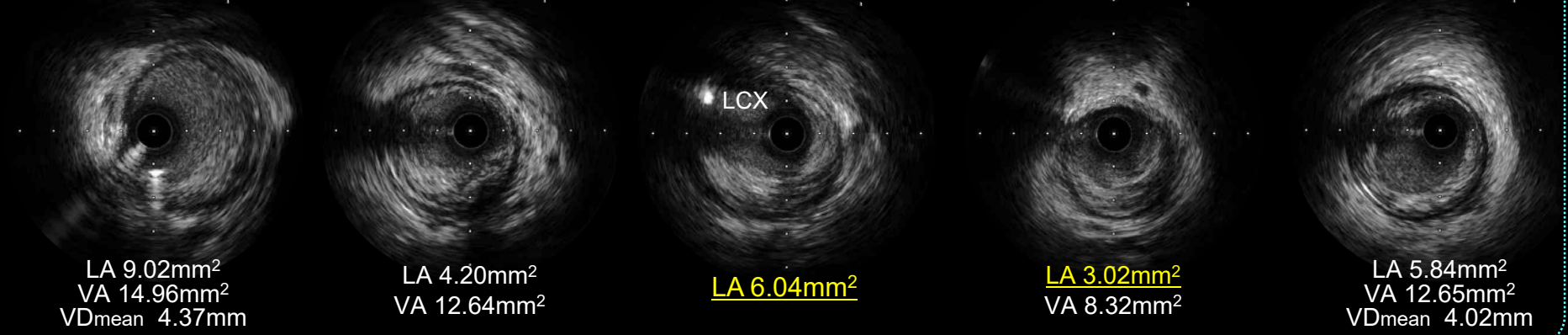
Role of Imaging Devices for Complex PCI

- 1.** evaluation of plaque composition and plaque location
- 2.** decision of stent sizing and stent strategy (one or two)
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- 7.** assessment of ISR underlying mechanism
- 8.** evaluation of recrossed SB wire location

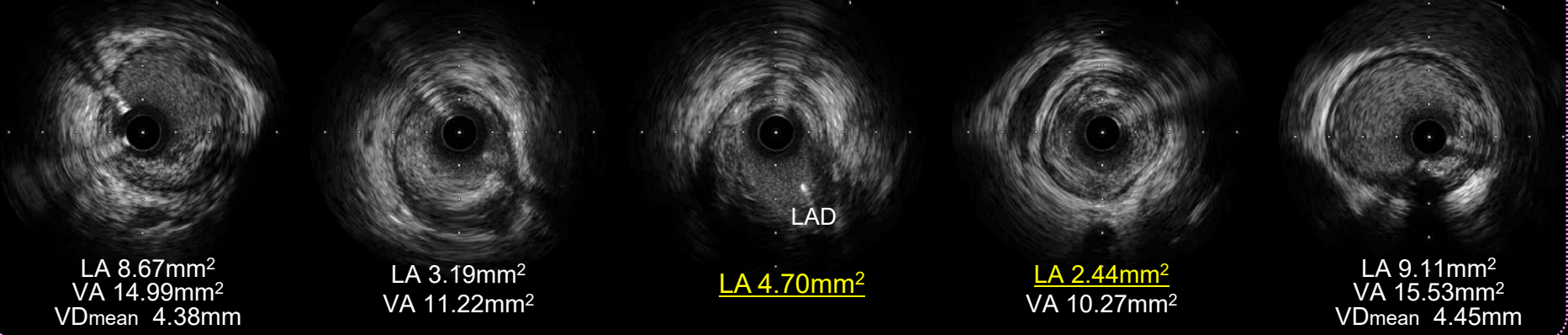
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1 LM reference 2 LM MLA 3 POC 4 LAD MLA 5 LAD reference



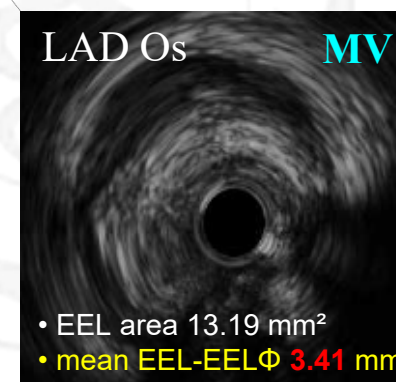
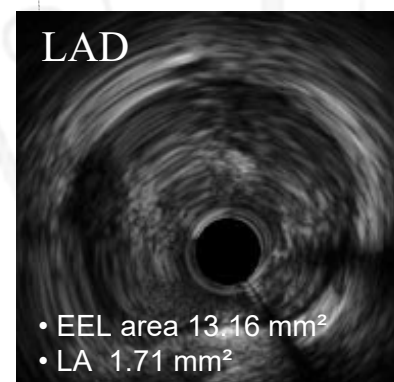
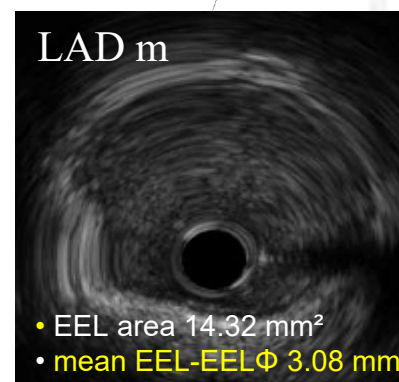
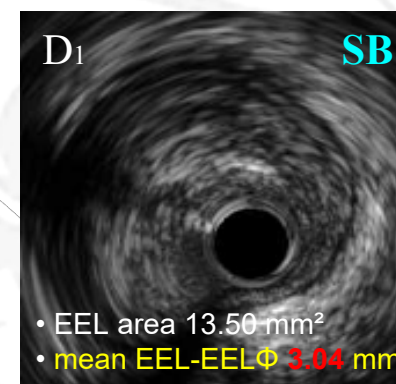
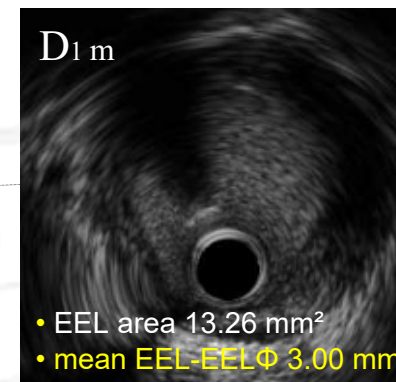
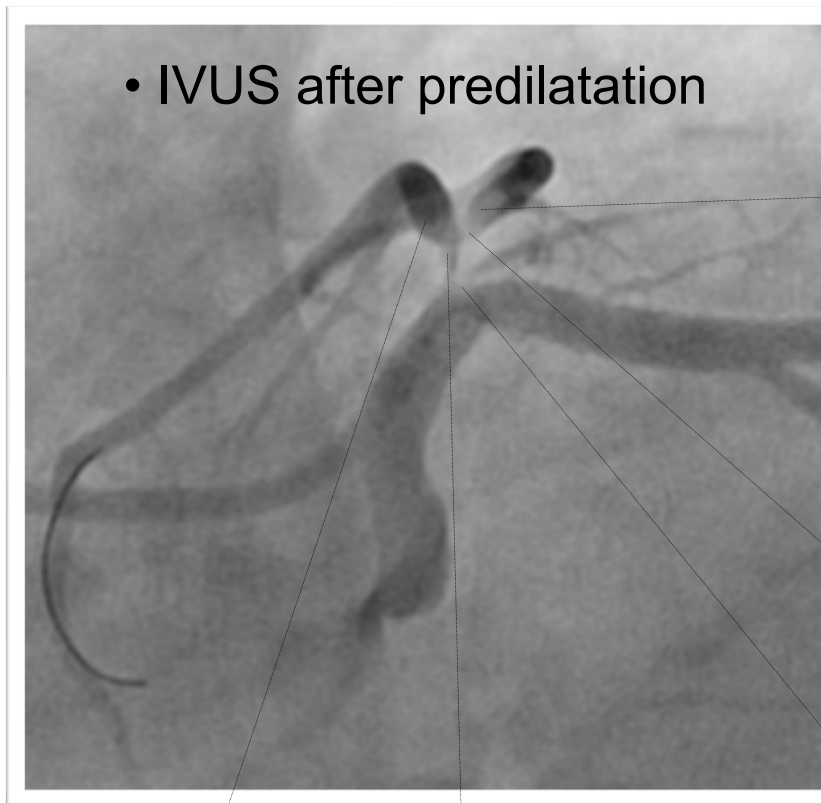
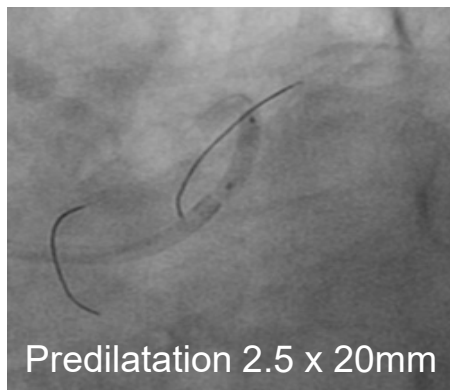
6 LM reference 7 LM MLA 8 POC 9 LCX MLA 10 LCX reference



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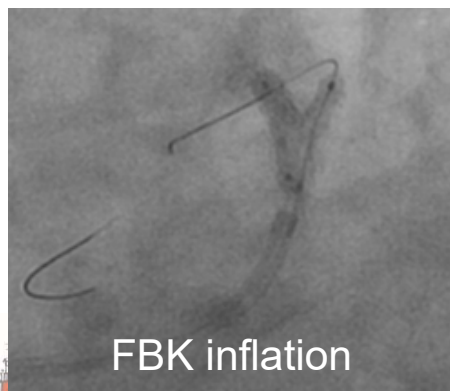
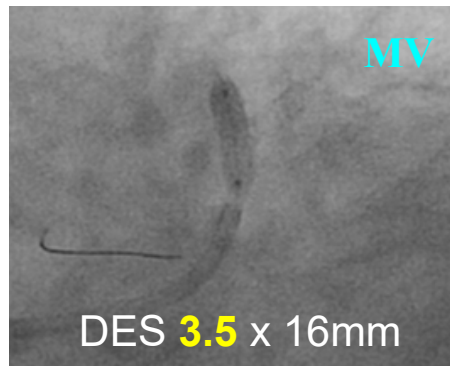
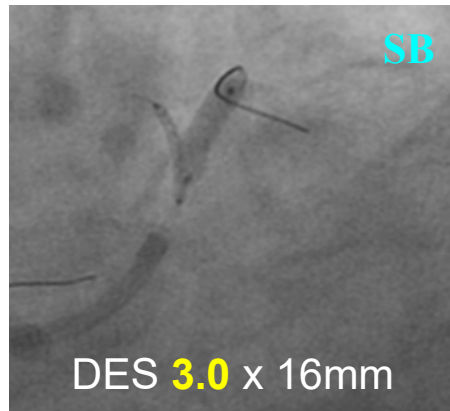
Case 2: 'Aggressive' IVUS Method for Stent Sizing in LAD Bif



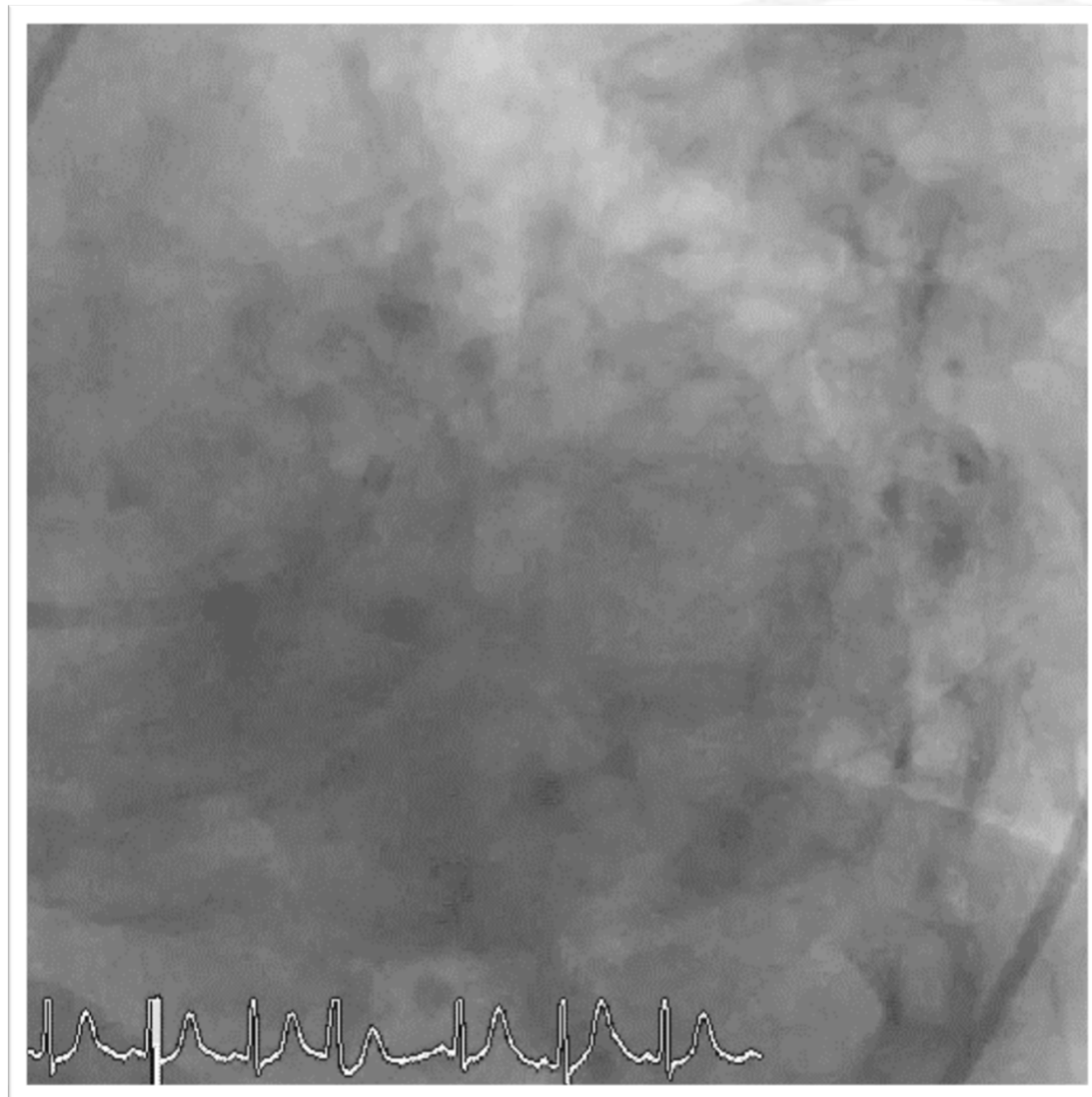
- 68 y.o. female
- unstable angina
- true bifur. lesion : Medina (1. 1. 1.)

LAD true
bifur. lesion

Case 2: Two stents with crushing technique



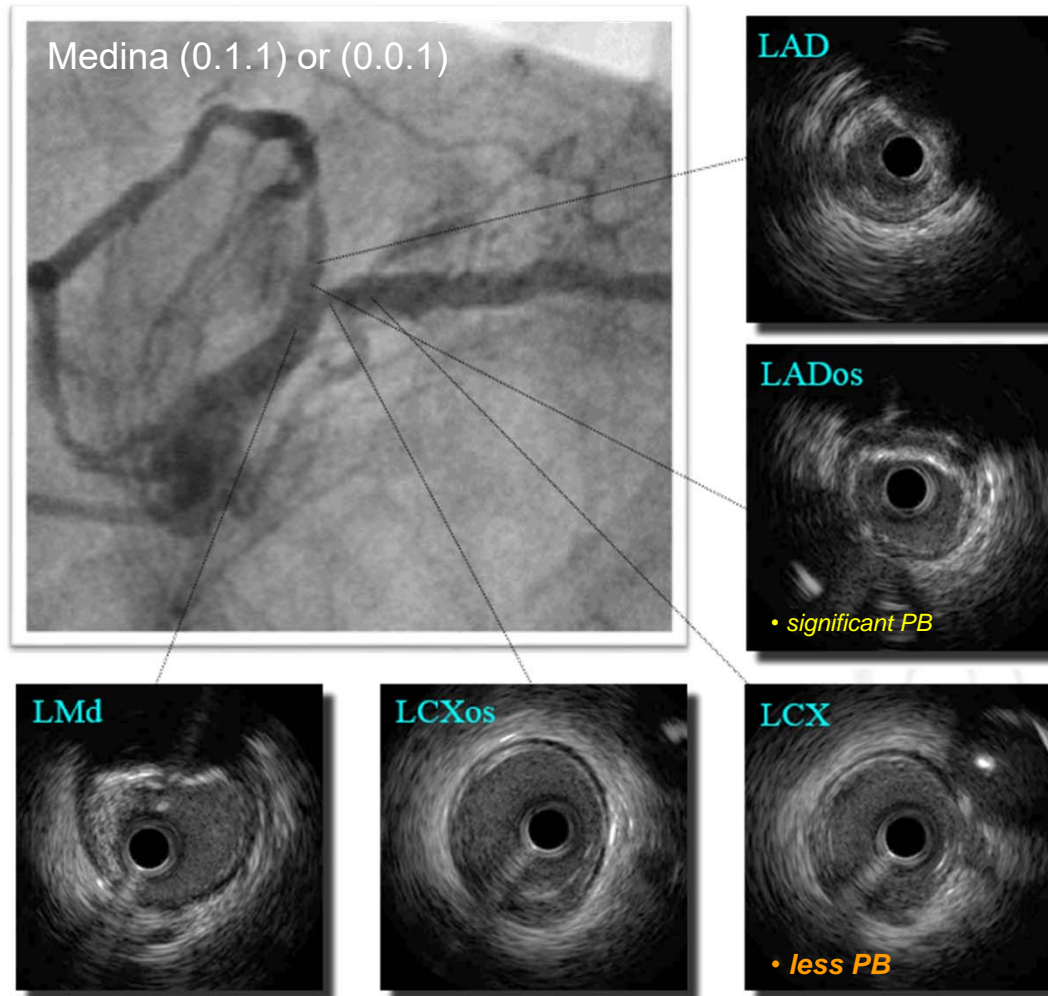
Final CAG



Case 3: Simple Crossover Stenting in LM Dz

Discrepancy between IVUS and Coronary angiogram

- LCXos & LADprox. lesion - 75 yo / ♀, sAP



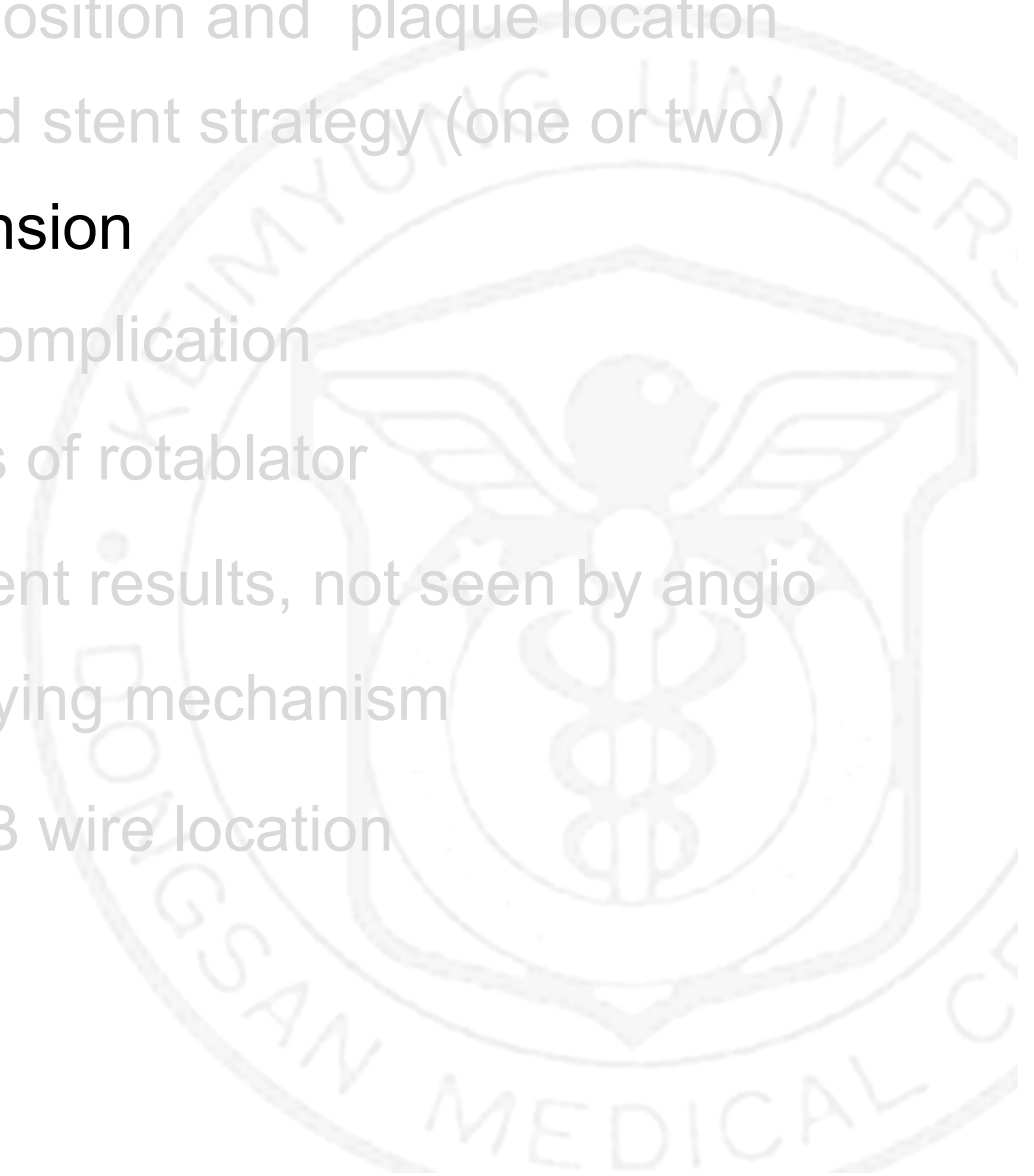
“**less plaque**” in LCXos
⇒ “**1 stent**” (LM-LAD)



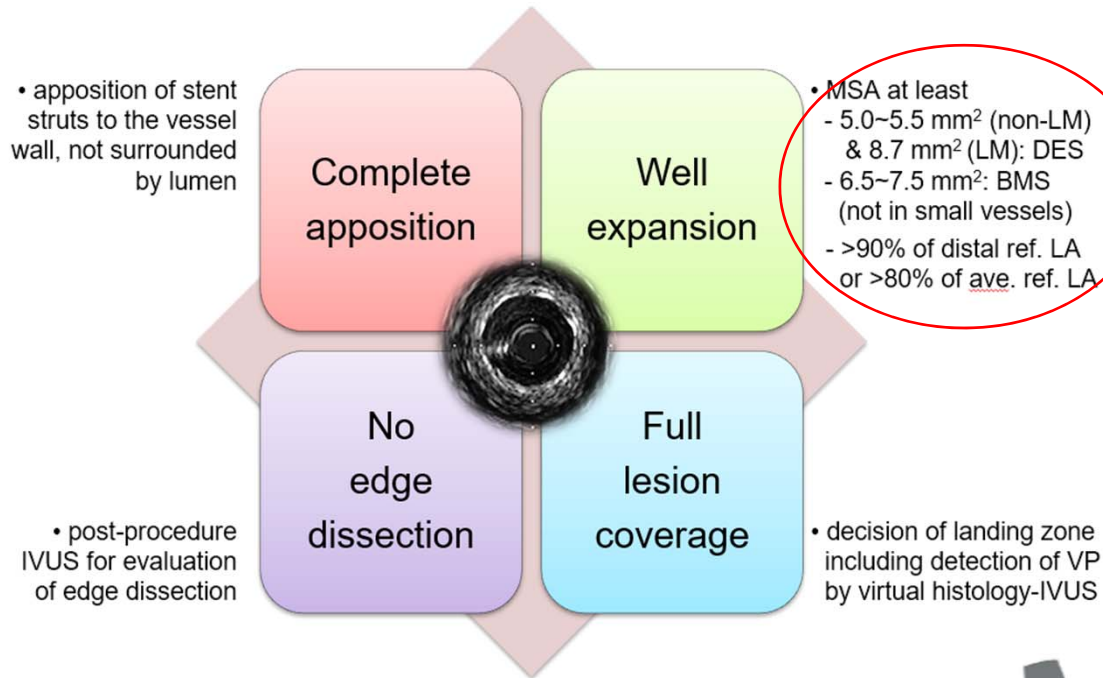
Intravascular imaging
can **determine**
either one- or
two-stent strategy

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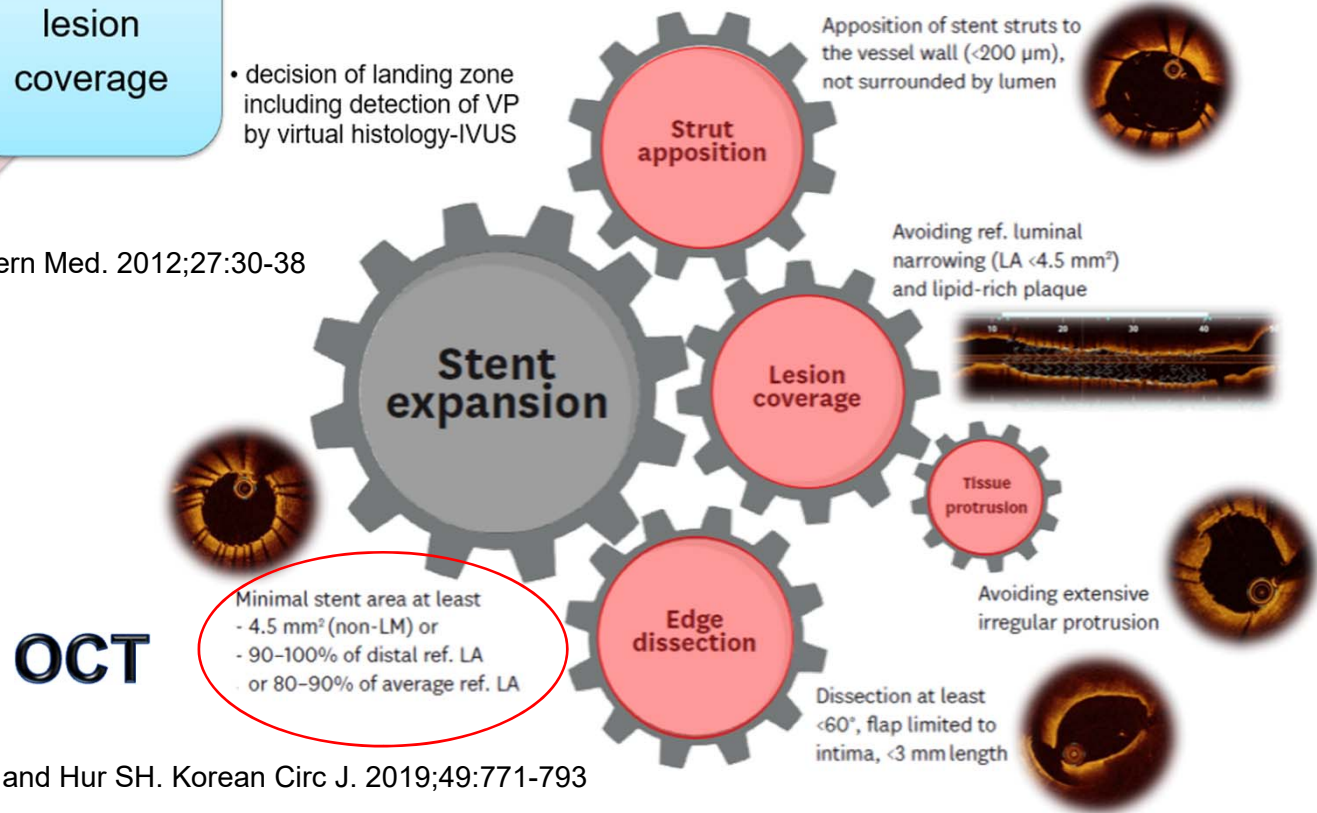
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Suggested Stent Expansion Criteria



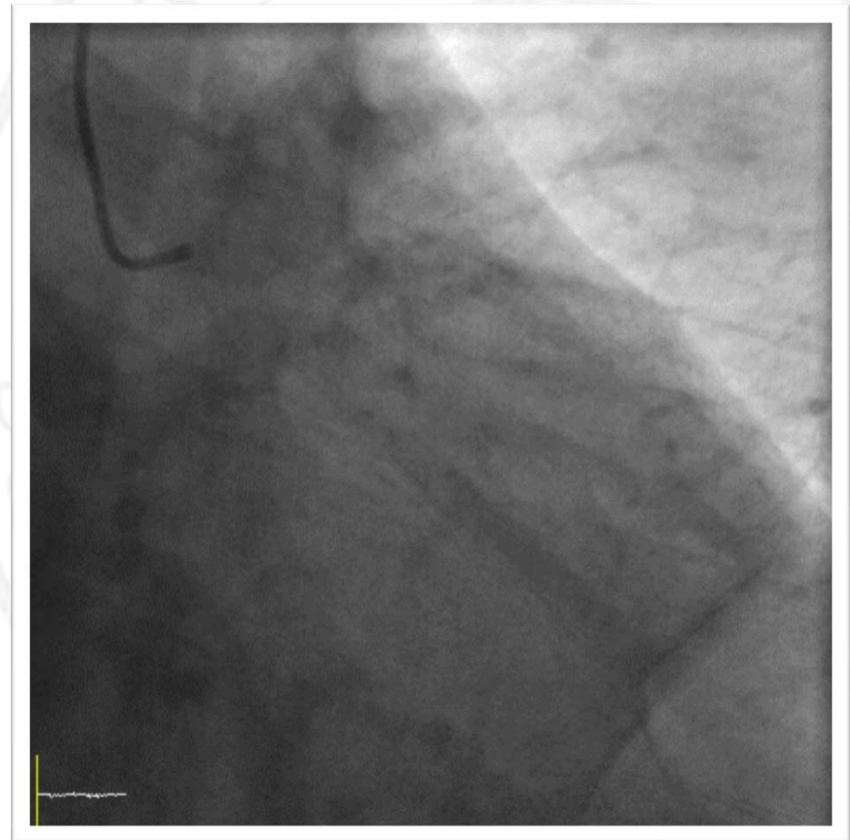
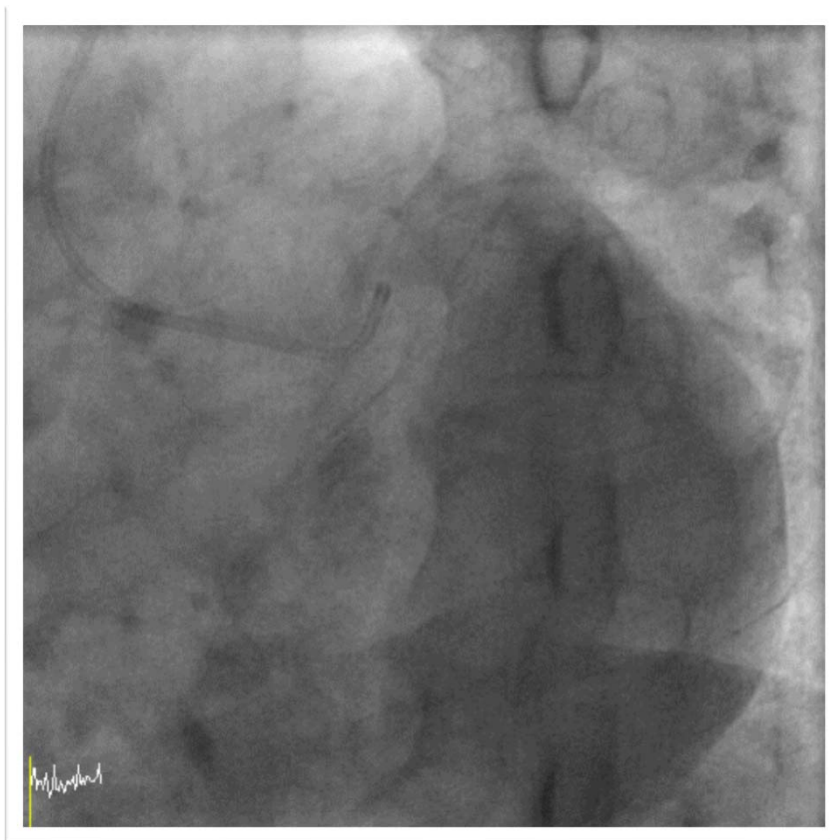
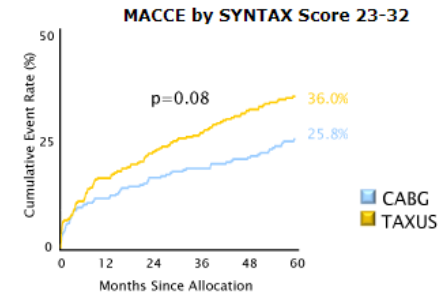
Yoon HJ and Hur SH. Korean J Intern Med. 2012;27:30-38



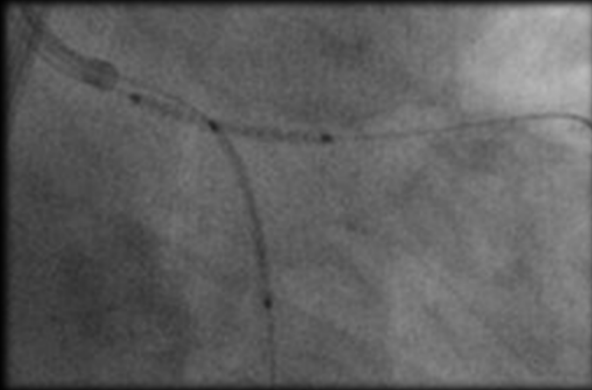
Lee CH and Hur SH. Korean Circ J. 2019;49:771-793

Case 4: Assessment of Stent Expansion after LM Bifurcation Stenting

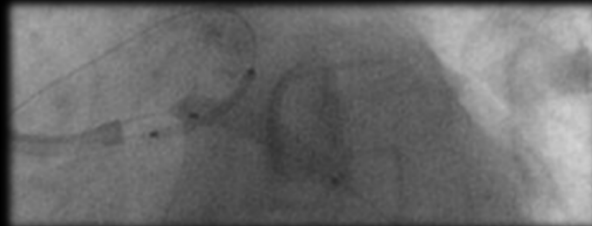
- 59 yo / ♂
- risk factors: HTN (+), HL (+)
- syntax score: 27
- stable anigna



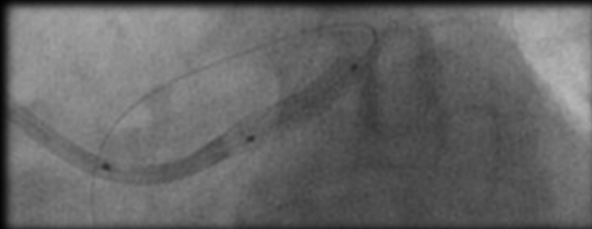
Case 4



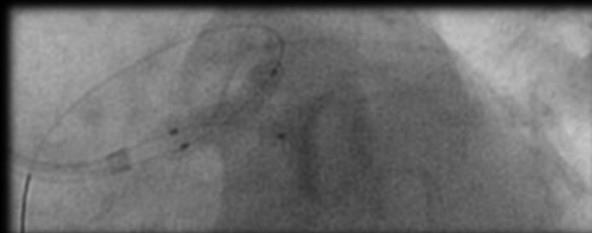
2 stents
strategy



EES 3.0*18mm
16 atm for
LM to LCX



EES 3.5*18mm
12atm for
LM to LAD



KB inflation
3.5mm for LAD, 16 atm
2.5mm for LCX, 16 atm

Crushing Stenting



KB Inflation

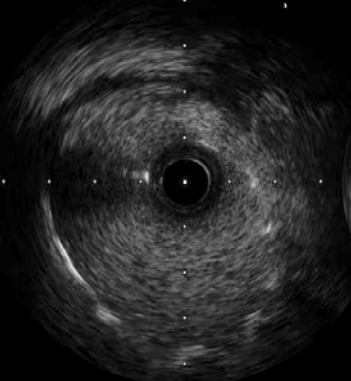


Final CAG



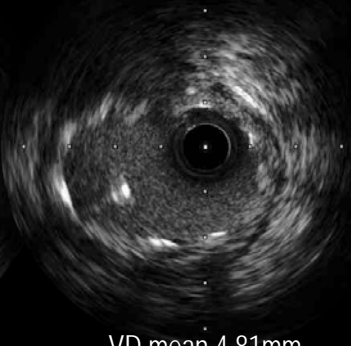
Final IVUS Pullback of **LAD** after KBI

A. LM Prox. Stent edge



SD mean 4.79mm
SA 18.14mm²

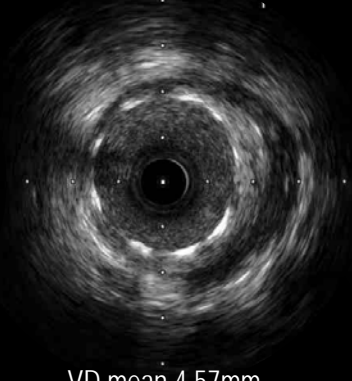
B. LM distal (POC) MSA



VD mean 4.81mm
SD mean 3.63mm

SA 10.45mm²

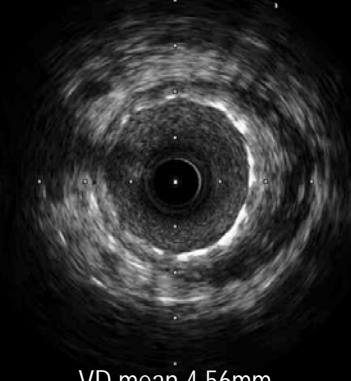
C. LAD MSA



VD mean 4.57mm
SD mean 3.23mm

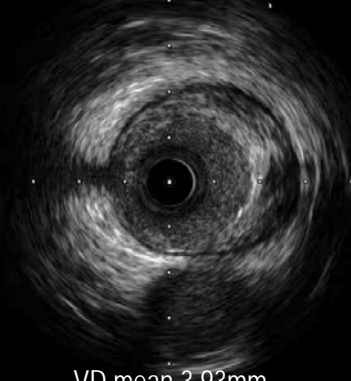
SA 8.12mm²

D. LAD Dist. Stent edge

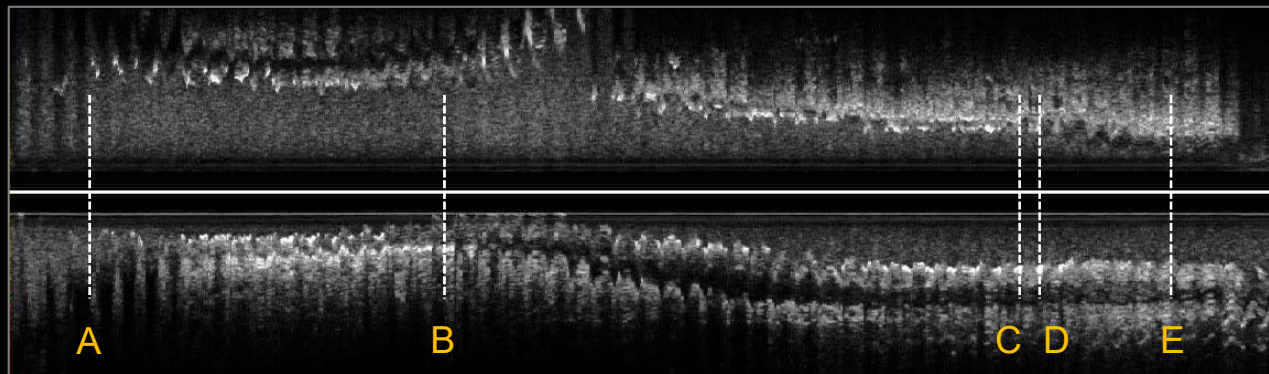
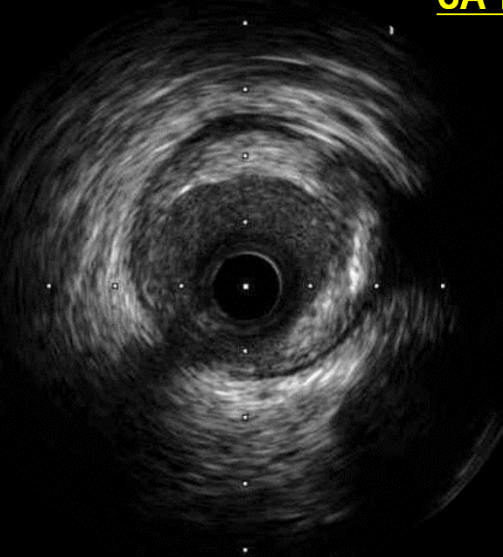


VD mean 4.56mm
SD mean 3.25mm
SA 8.24mm²

E. LAD Dist. reference



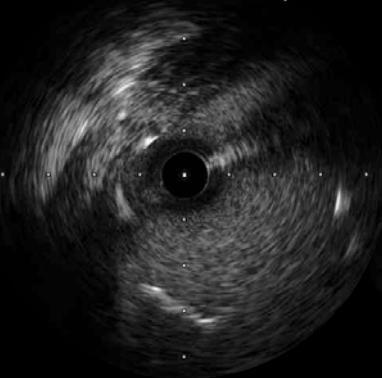
VD mean 3.93mm
LD mean 3.05mm
LA 7.25mm²



← proximal Stent length 18.60mm (Xience 3.5*18) distal →

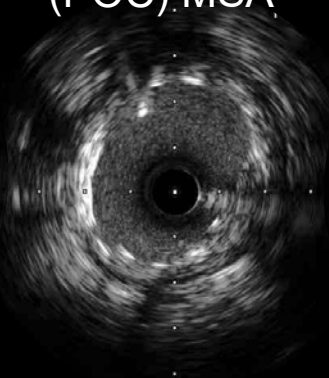
Final IVUS Pullback of **LCX** after KBI

A. LM Prox. Stent edge



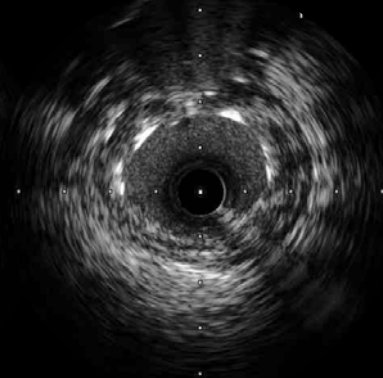
SD mean 4.67mm
SA 17.21mm²

B. LM distal (POC) MSA



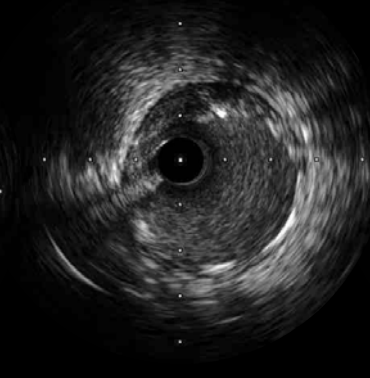
VD mean 4.82mm
SD mean 3.56mm
SA 10.04mm²

C. LCX MSA



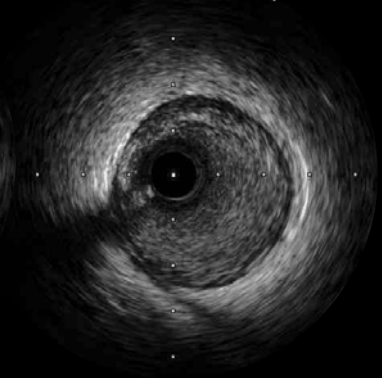
VD mean 4.31mm
SD mean 2.89mm
SA 6.51mm²

D. LCX Dist. Stent edge

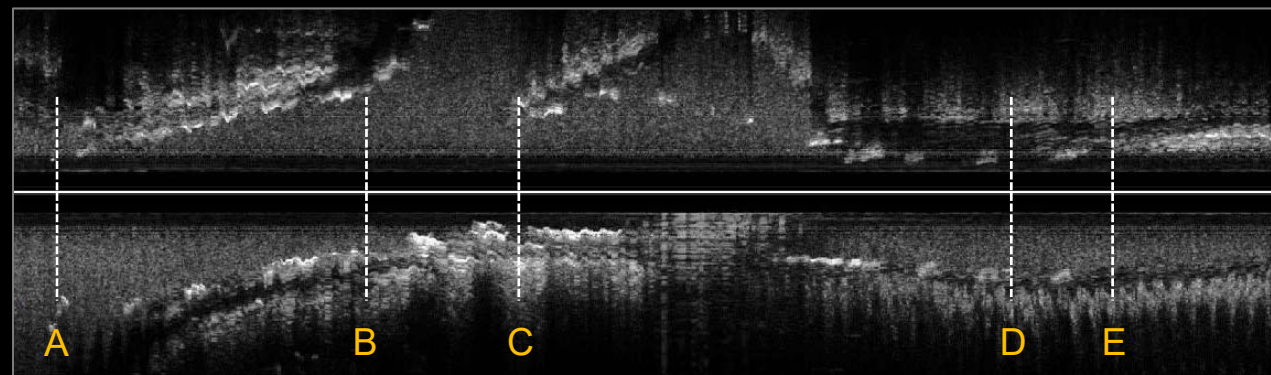
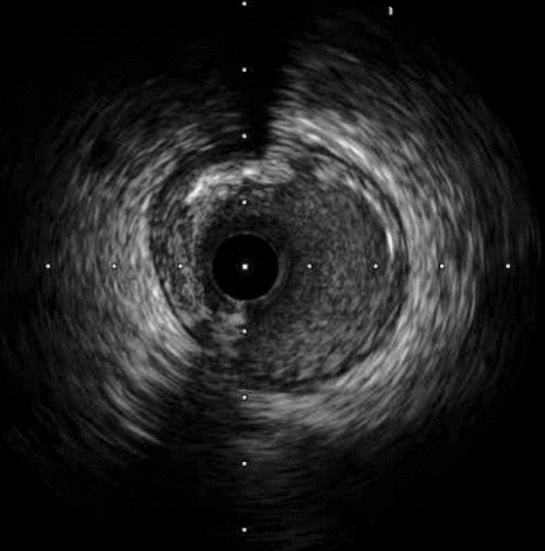


VD mean 4.16mm
SD mean 3.39mm
SA 8.95mm²

E. LCX Dist. reference



VD mean 3.95mm
LD mean 3.36mm
LA 8.78mm²



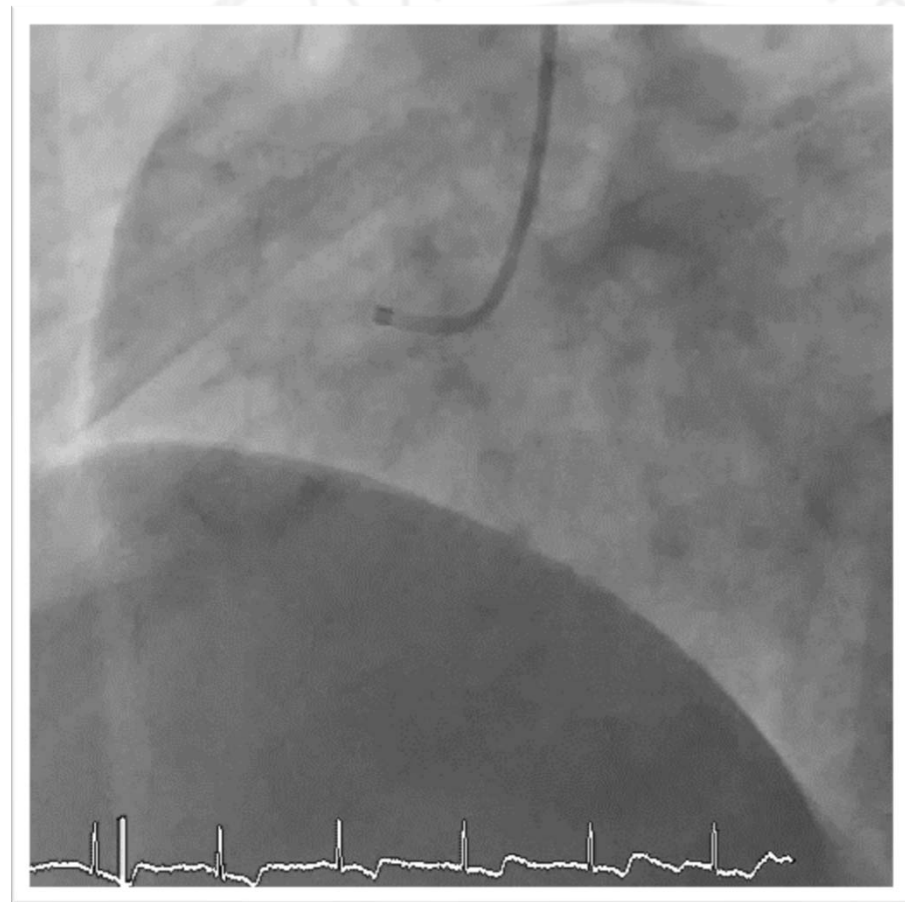
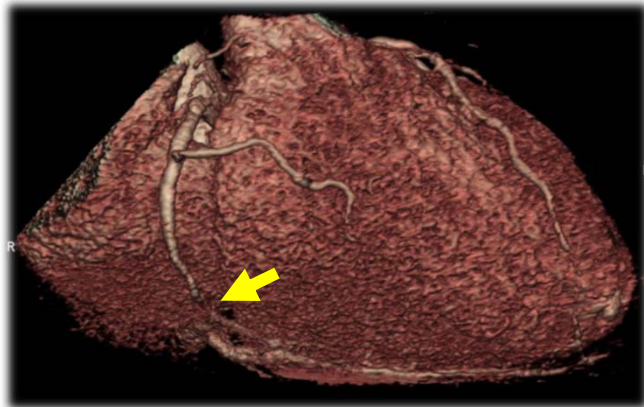
← proximal Stent length 22.45mm (Xience 3.0*18) distal →

Role of Imaging Devices for Complex PCI

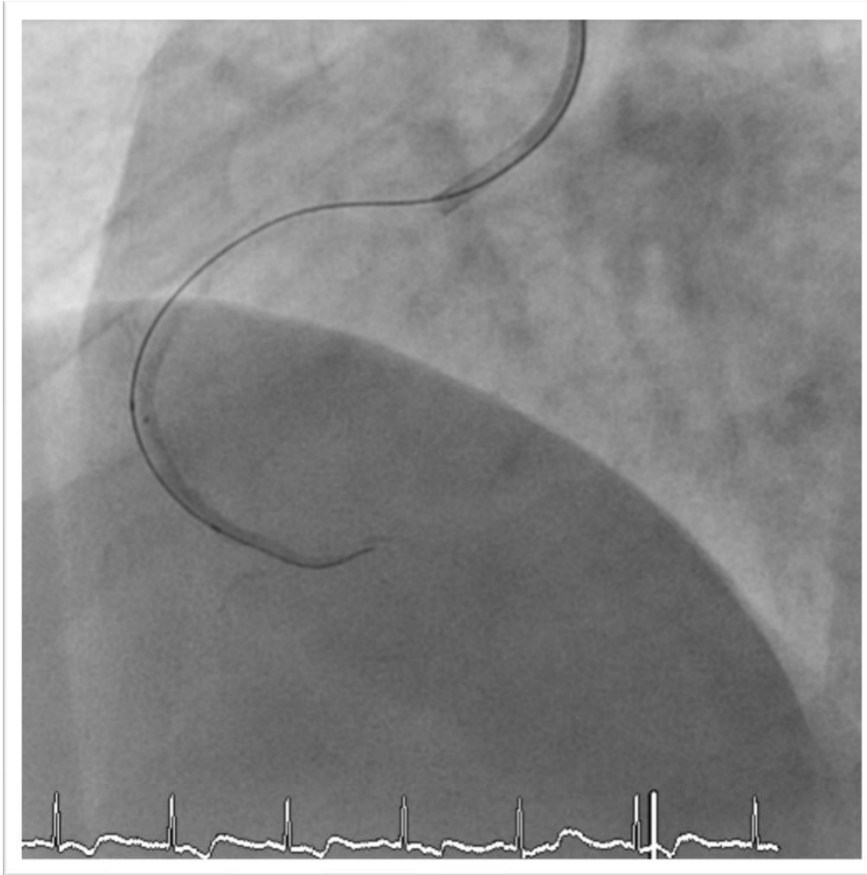
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Case 5: IVUS-guided CTO Intervention

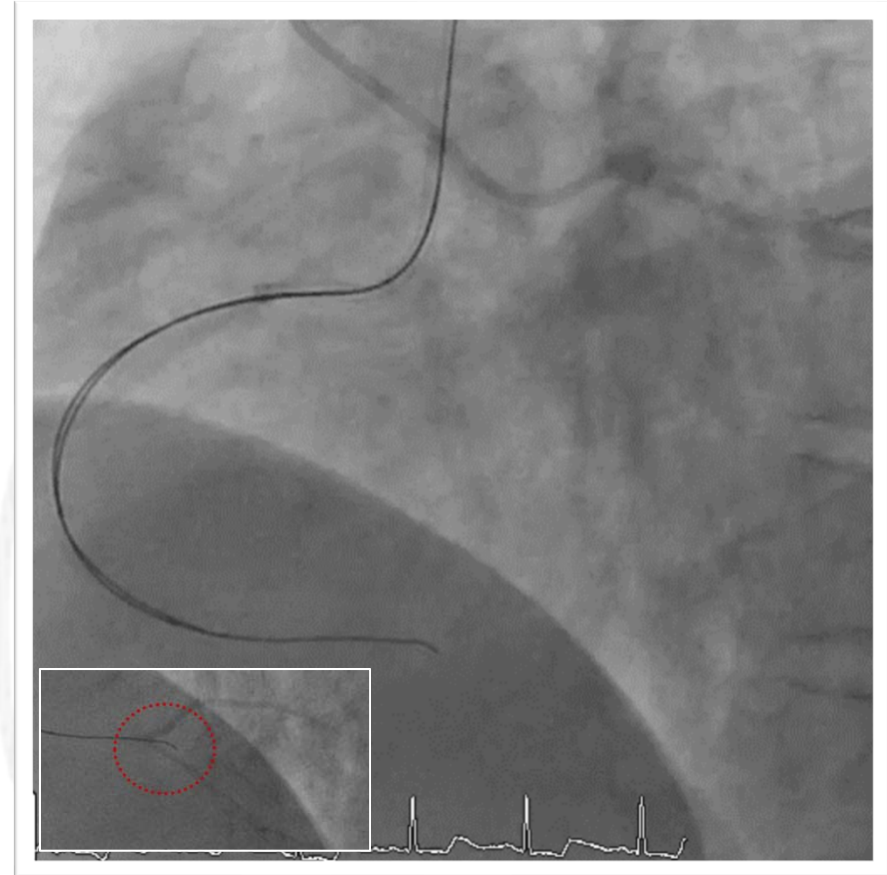
- 51 yo / ♀
- risk factors: HTN (+), DM (+), HL (+)
- **stable angina**



Wire escalation and parallel wire technique



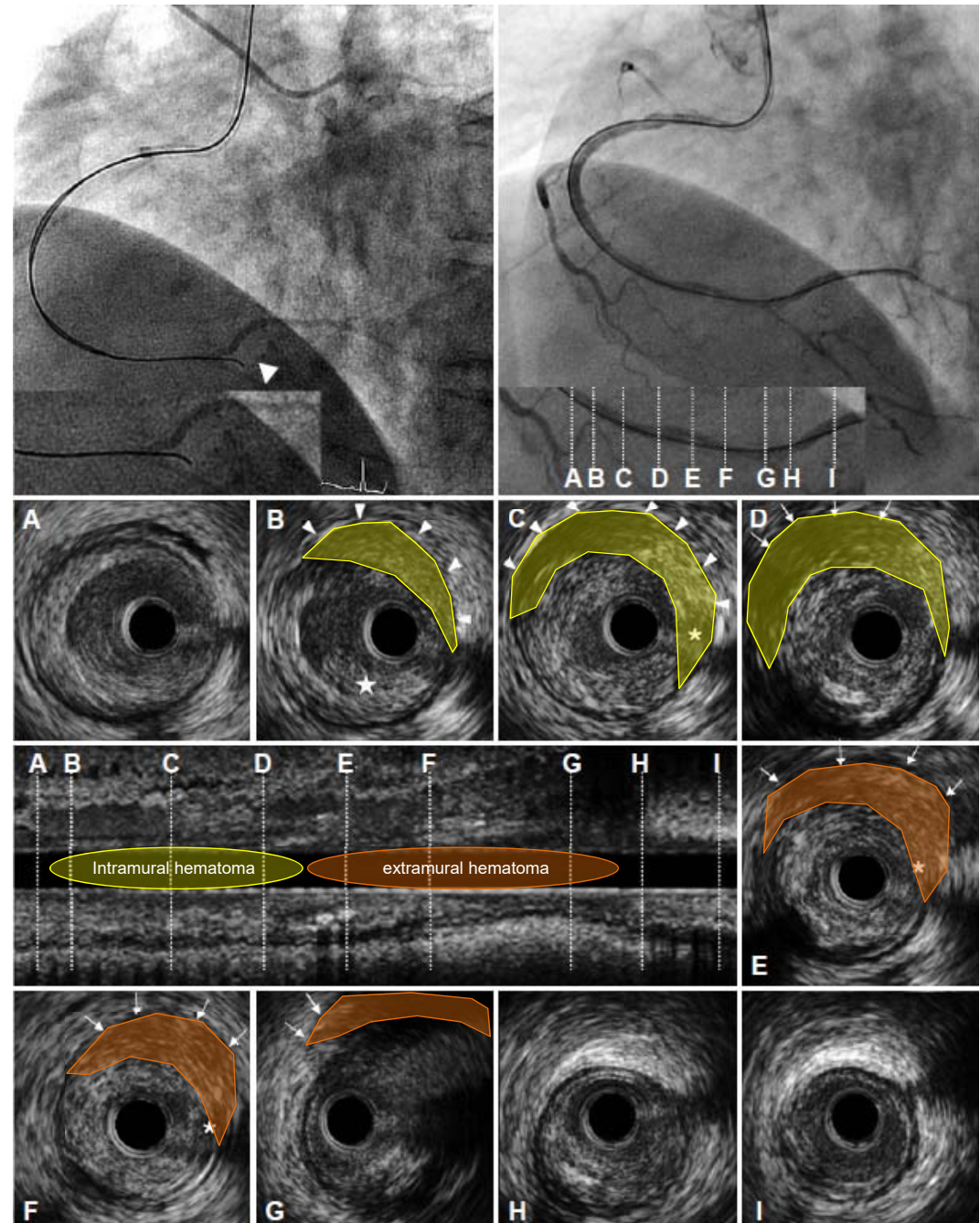
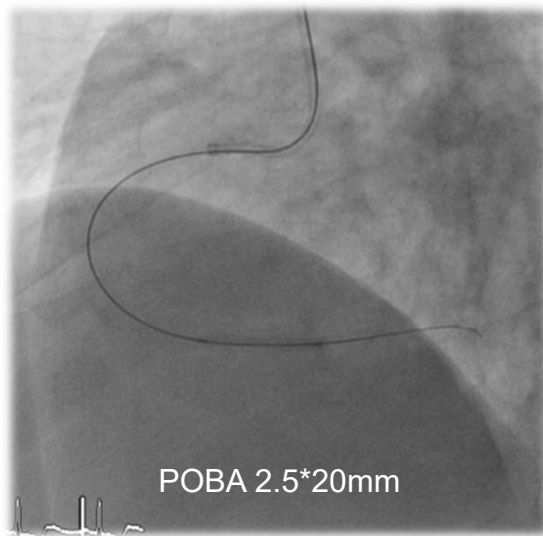
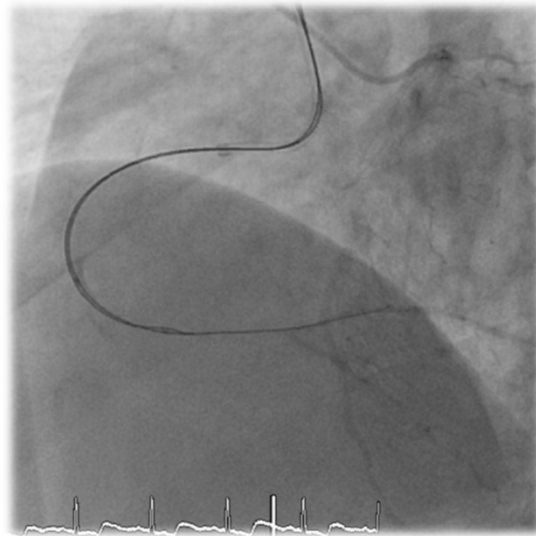
OTW with PT II →
Miracle 3g → 6g → 12g



Parallel wire technique
(Miracle 12g & Conquest Pro)

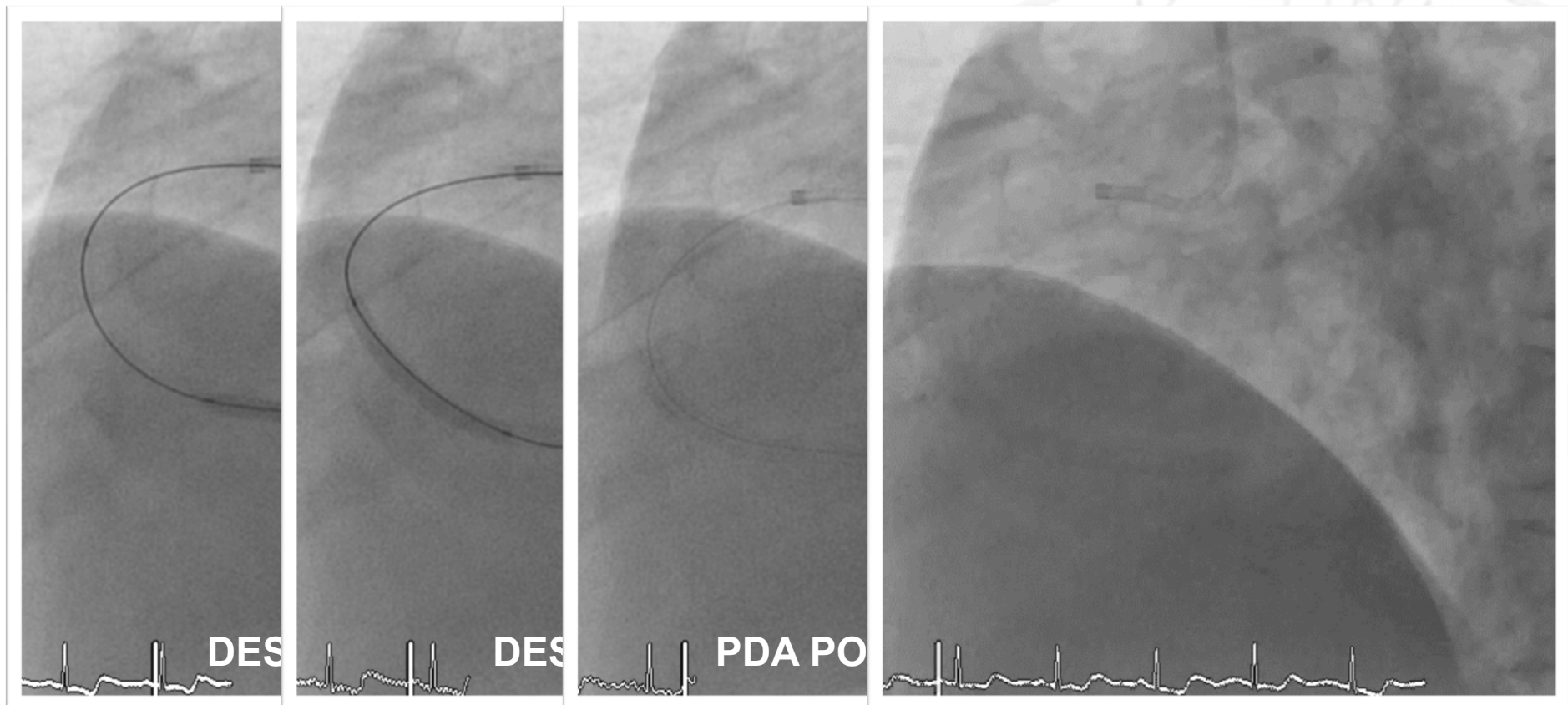
Case 5

Successful rewiring and predilatation followed by IVUS examination



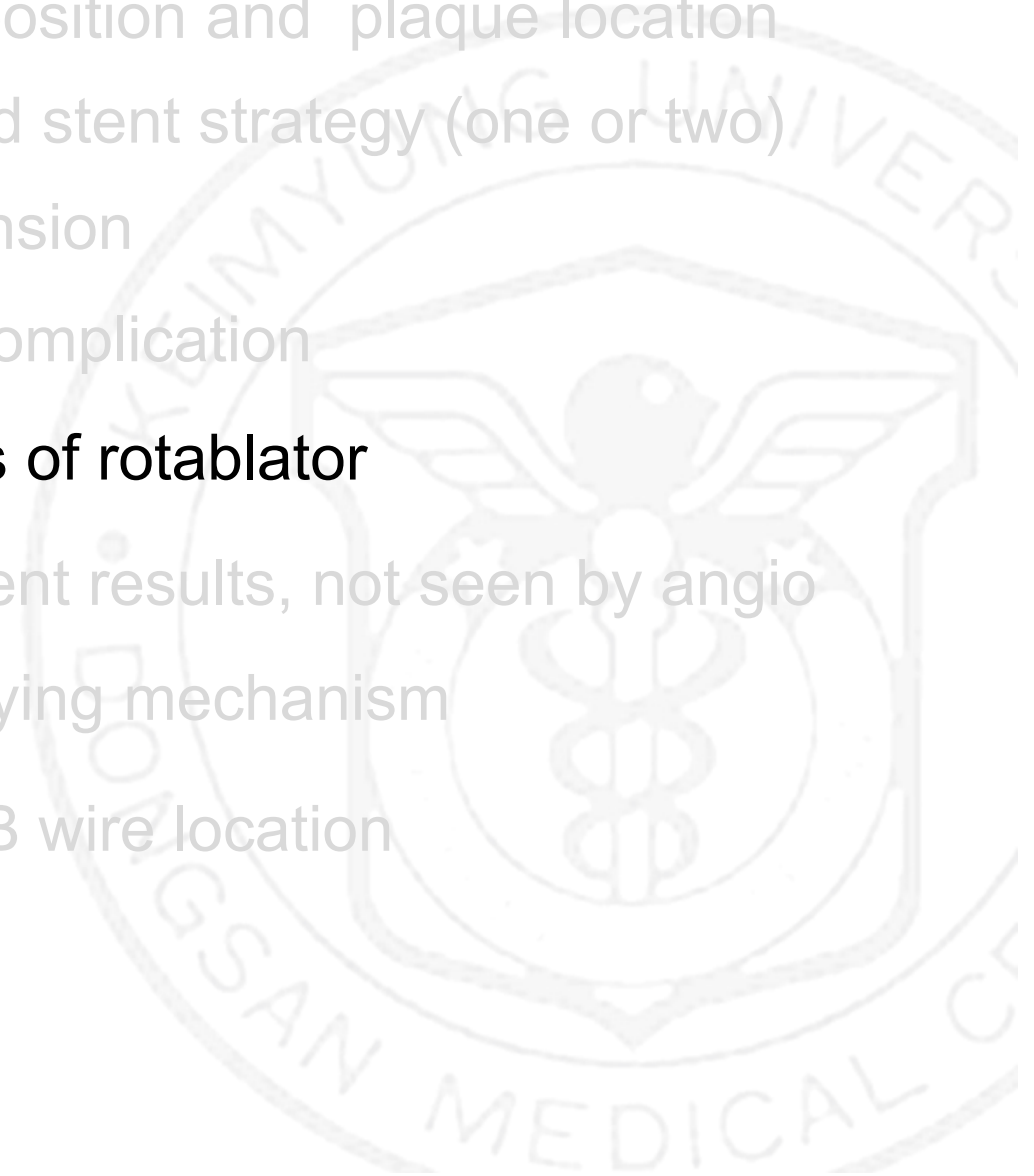
Final CAG

Overlapping stents implantation followed by SB POBA



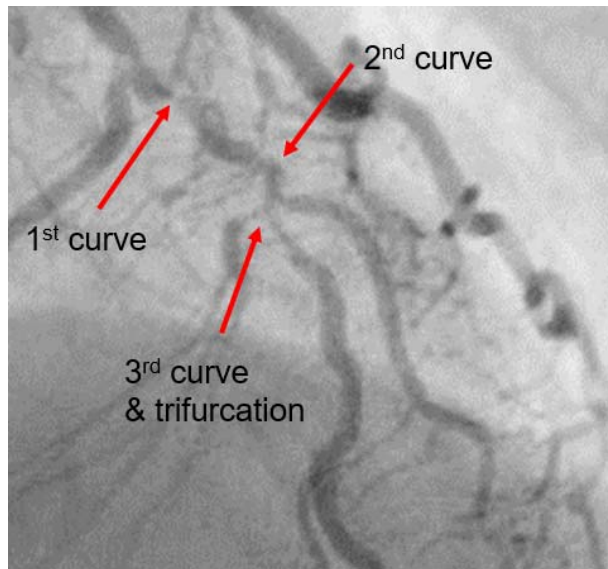
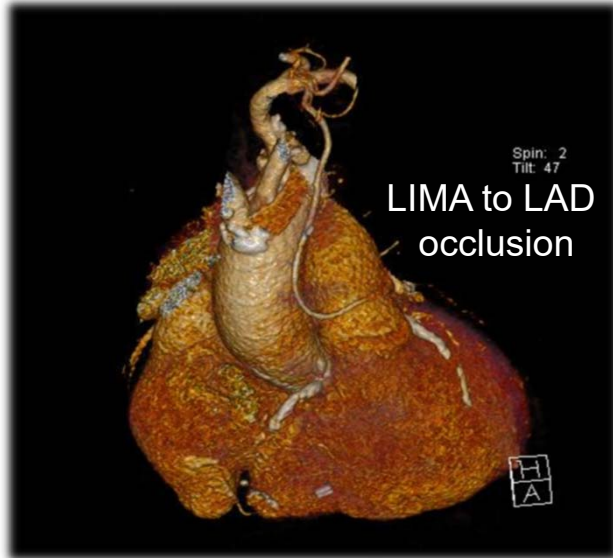
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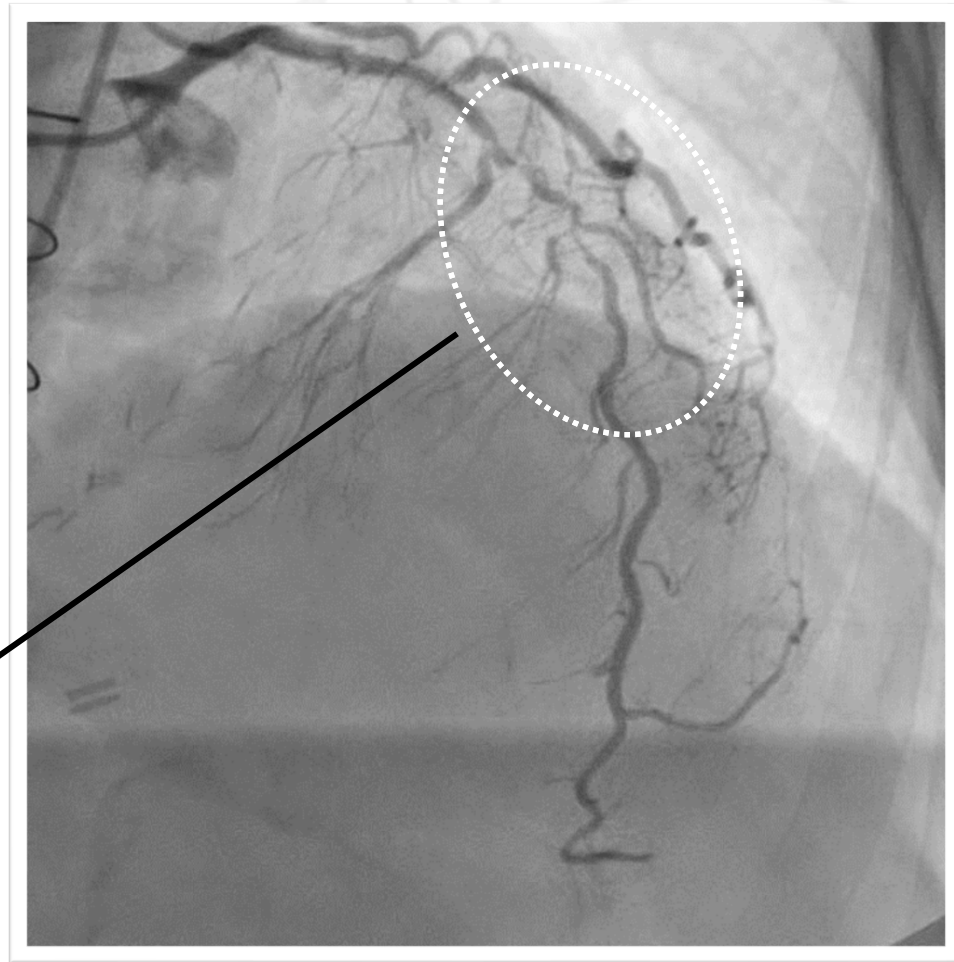


Case 6: IVUS Role in Severe Calcified Lesion

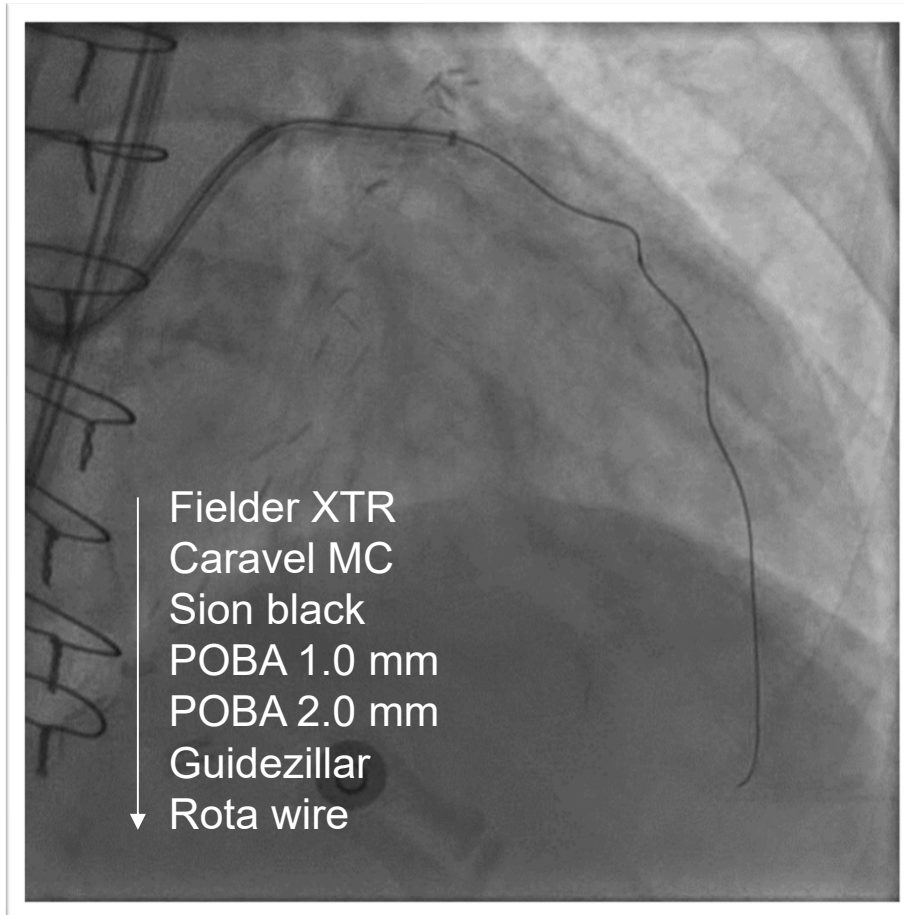
- 81 yo / ♀ • uAP+Severe AS+Atrial flutter+ NSCLC
- CABG (LIMA to LAD, tRA-OM3-RCA) • Echo:EF 28%, global wall motion abnormality



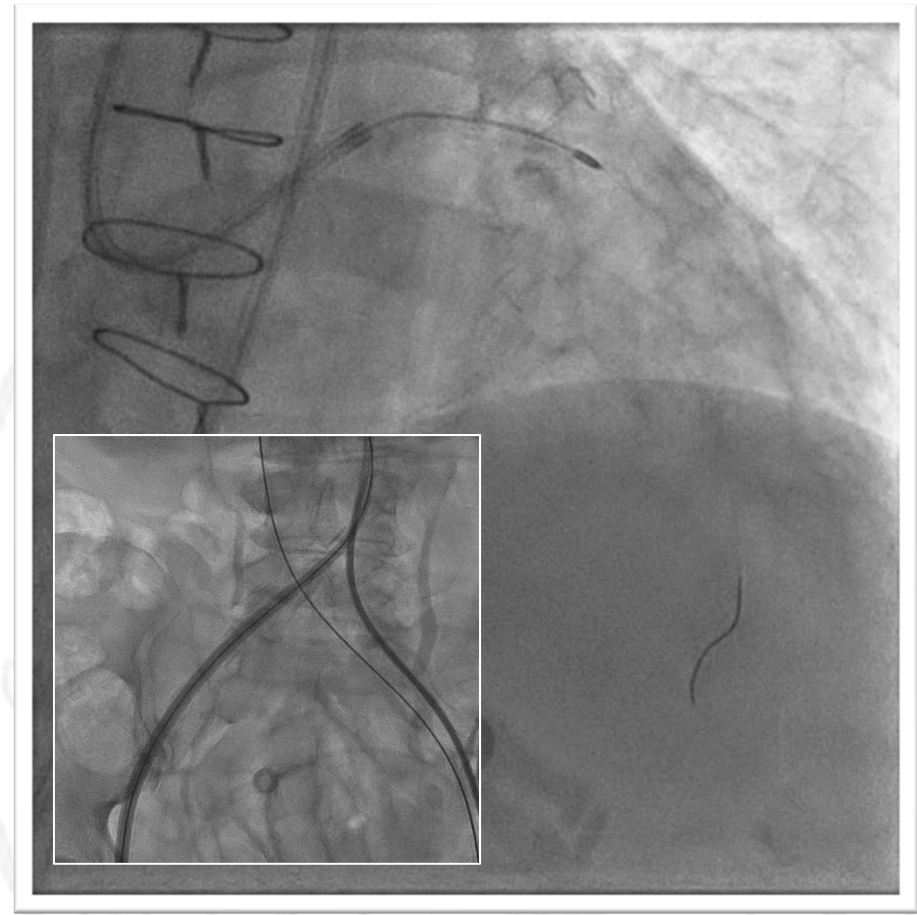
- native mLAD
: angulated lesion w/ severe calcification



Plaque modification

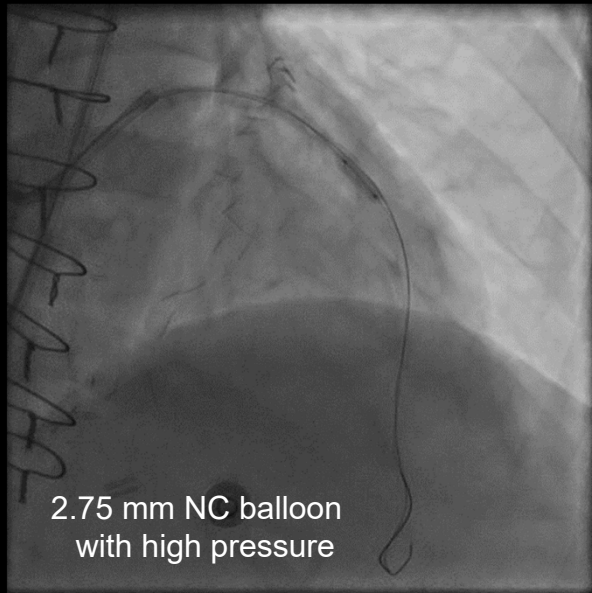
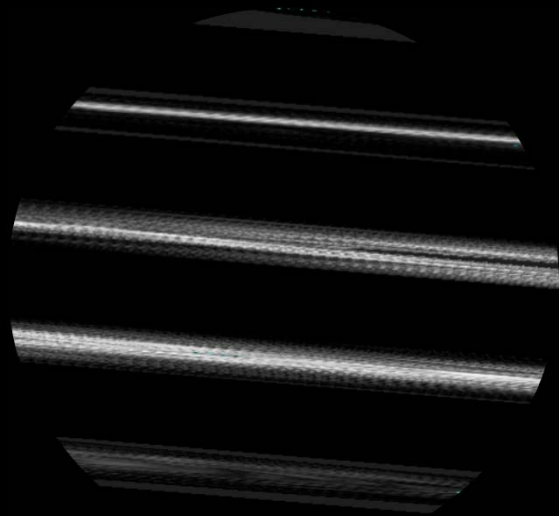


- Rota GW insertion using GW escalation with microcatheter

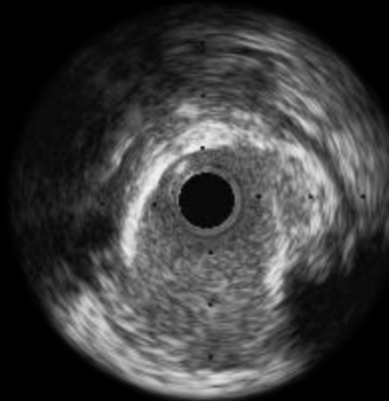


- Rotational atherectomy under ECMO support (1.25 to 1.5 mm burr)

NC balloon inflation followed by IVUS Examination

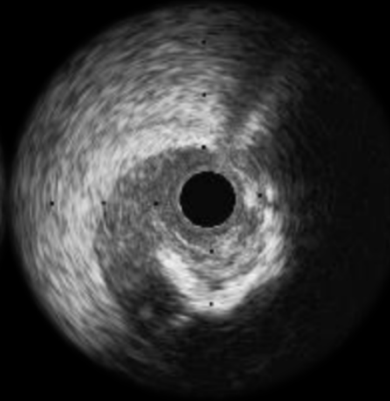


A. Prox. reference



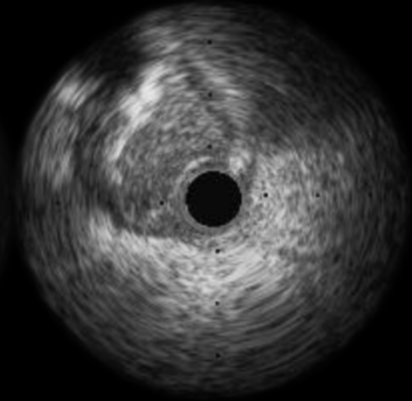
Lumen Mean D. 3.54mm
Min D. 2.91mm / Max D. 4.08mm
Vessel Mean D. 5.20mm
Min D. 5.07mm / Max D. 5.36mm

B. MLA site

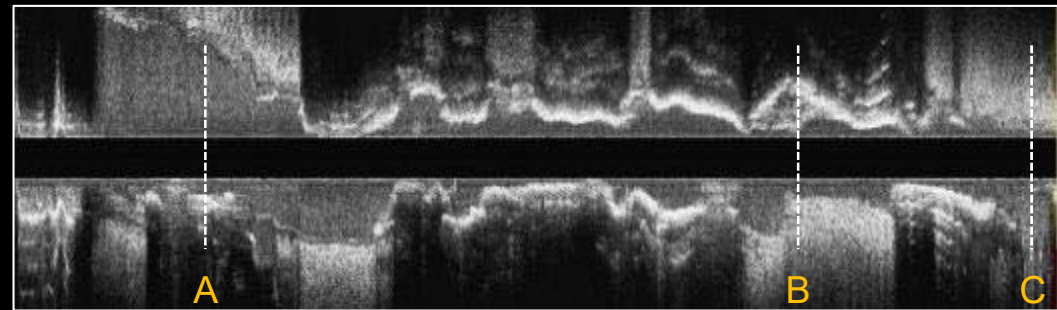


LA 2.05mm²
Min D. 1.47mm / Max D. 1.80mm
VA 11.54mm²
Min D. 3.58mm / Max D. 4.05mm
Plaque 82.2% of vessel

C. Dist. reference



Lumen Mean D. 2.20mm
Min D. 1.85mm / Max D. 2.62mm
Vessel Mean D. 3.22mm
Min D. 2.80mm / Max D. 3.71mm

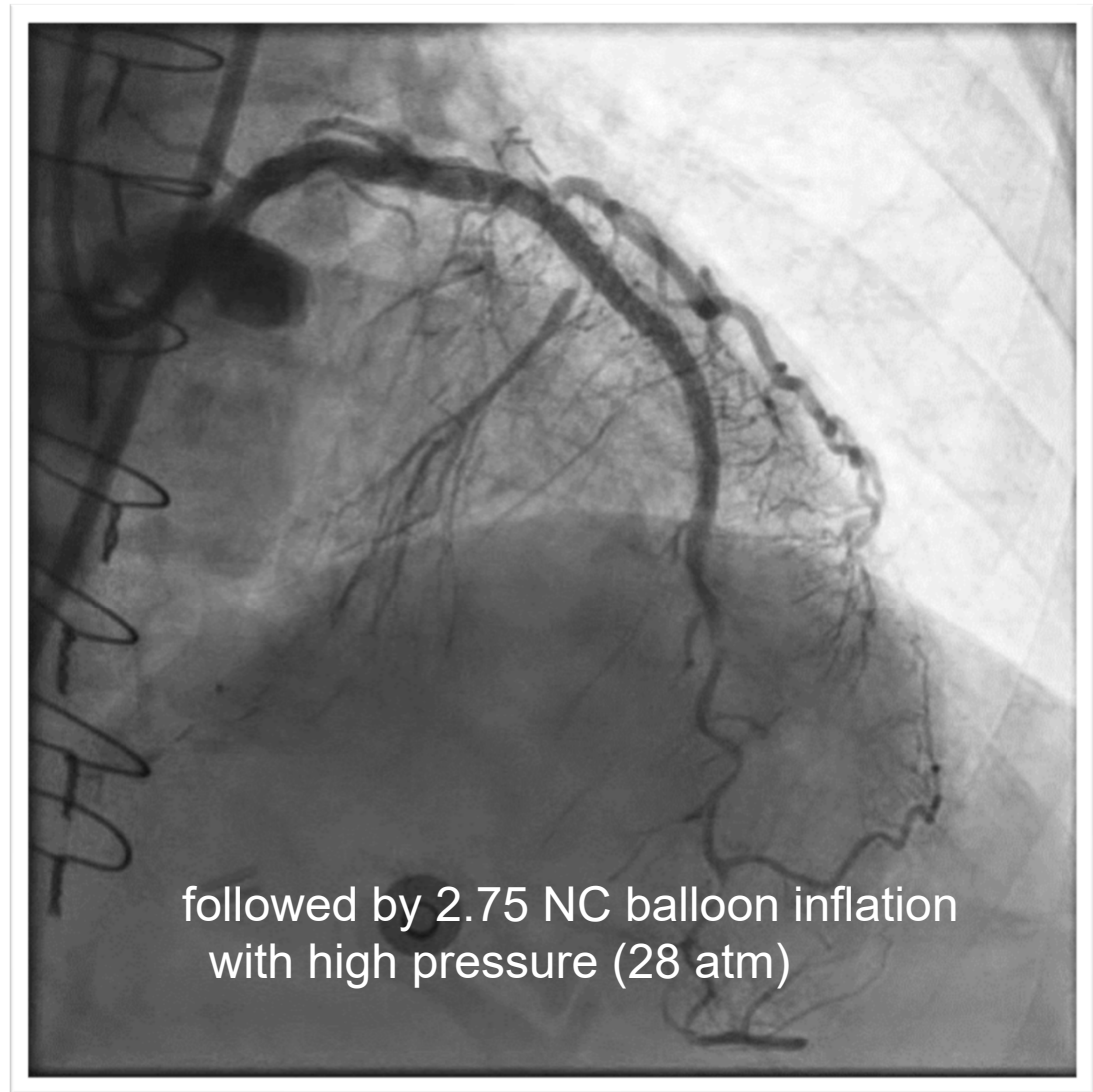
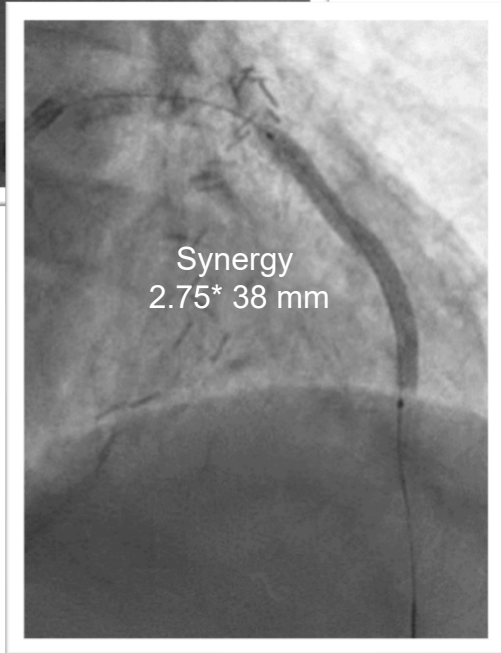
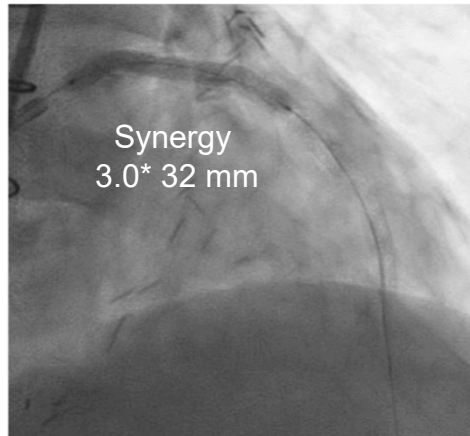


← proximal

Lesion length 50.92mm

distal →

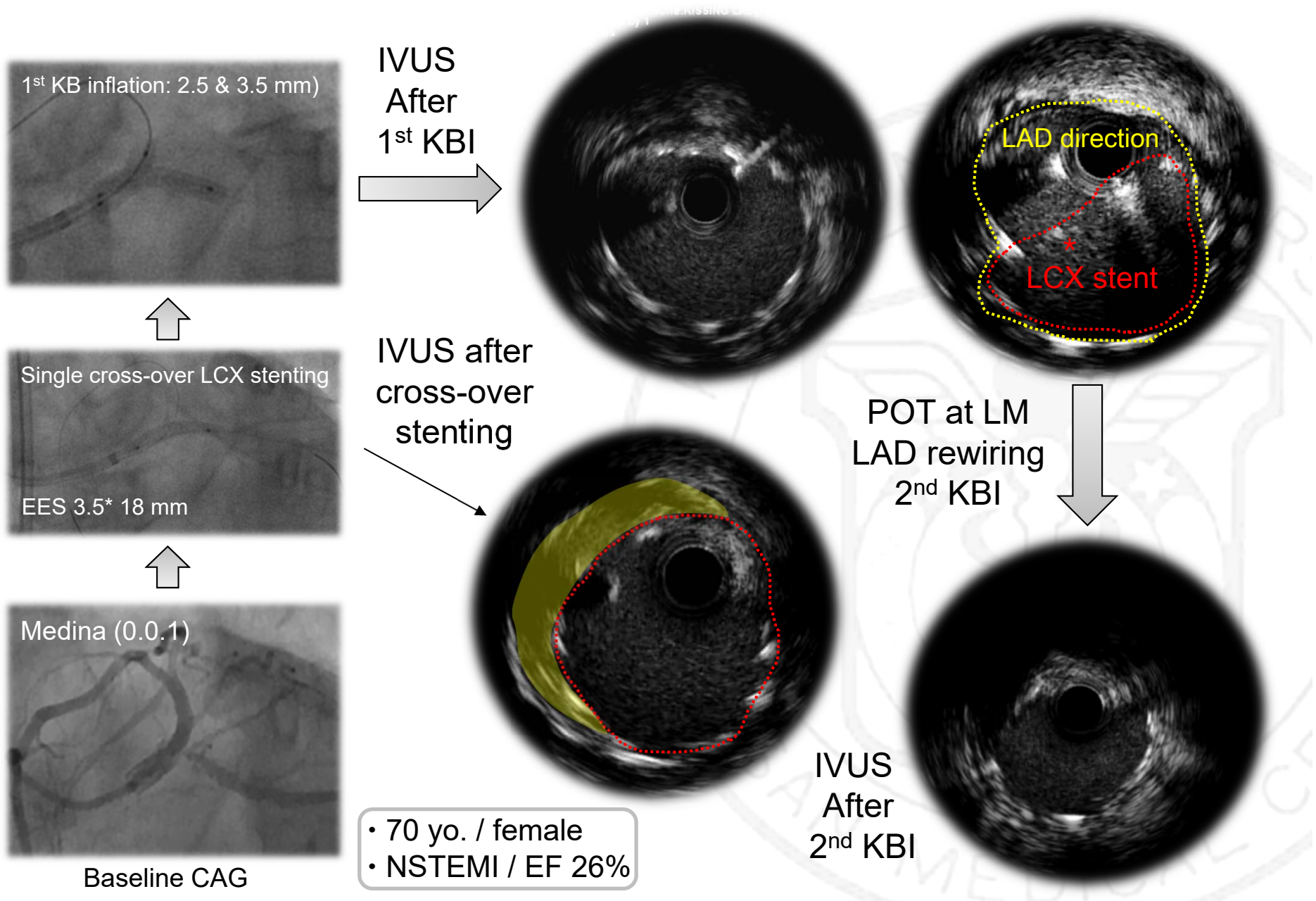
2 DESs Implantation and Final CAG



Role of Imaging Devices for Complex PCI

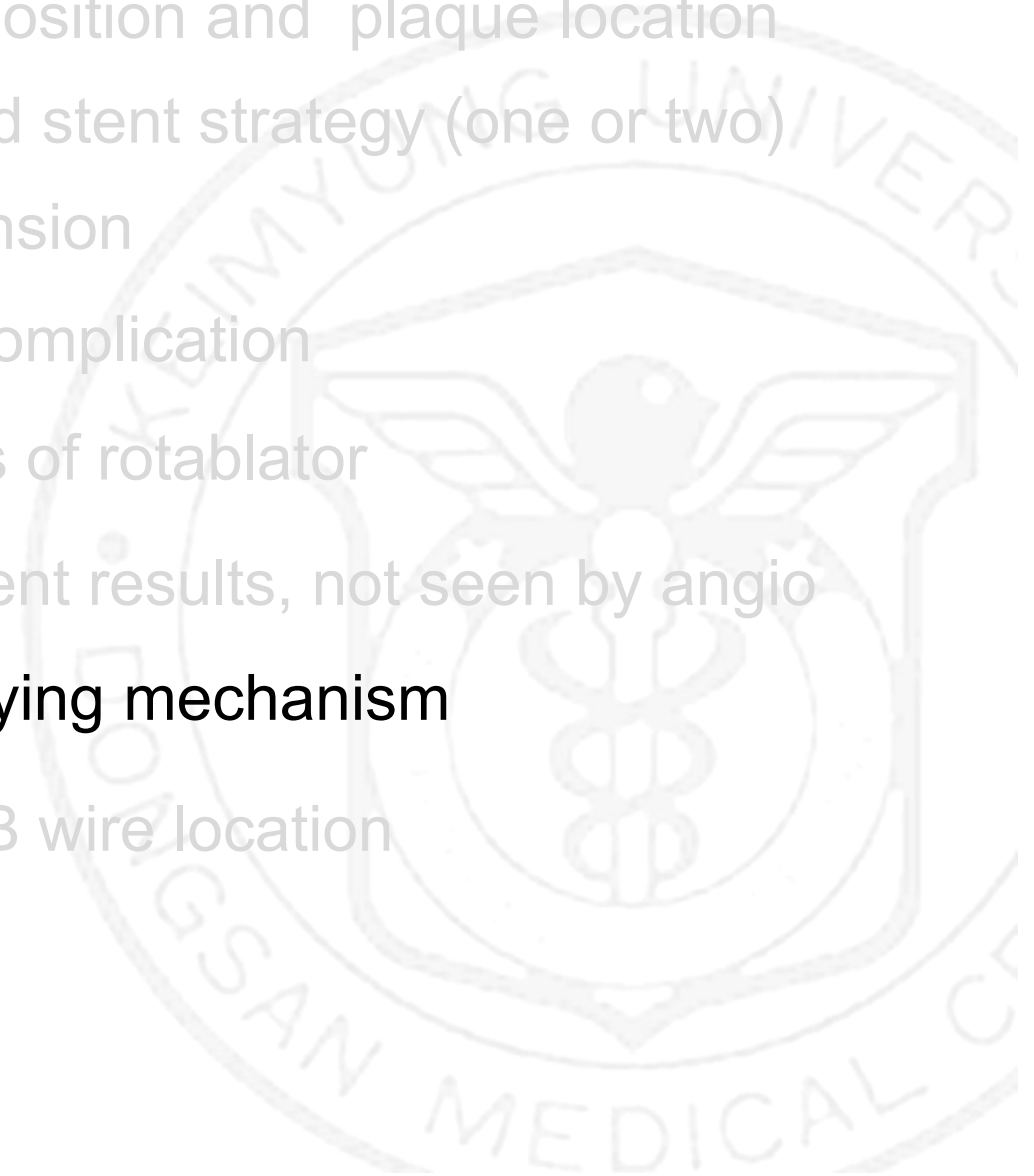
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Case 7: Accidental Abluminal Rewiring during KBI


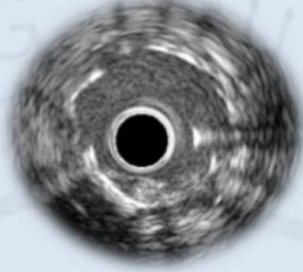


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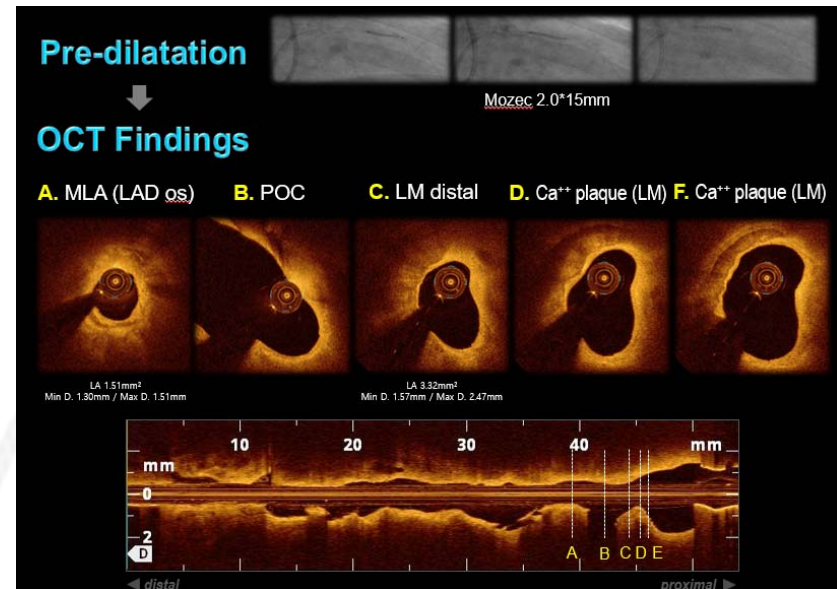
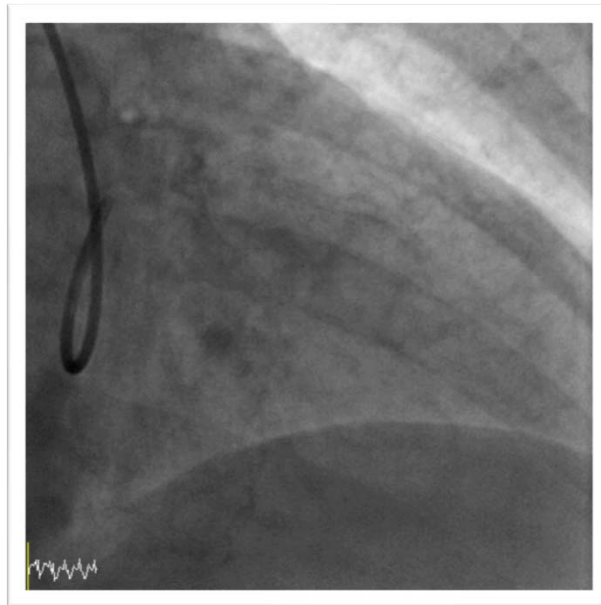
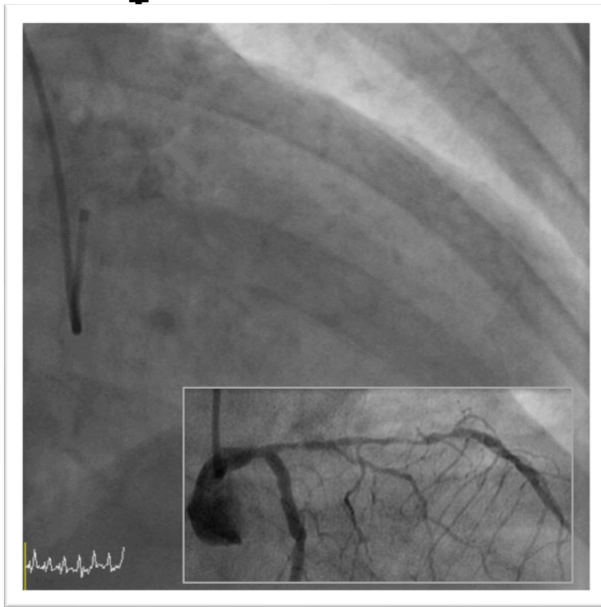


OCT vs. IVUS

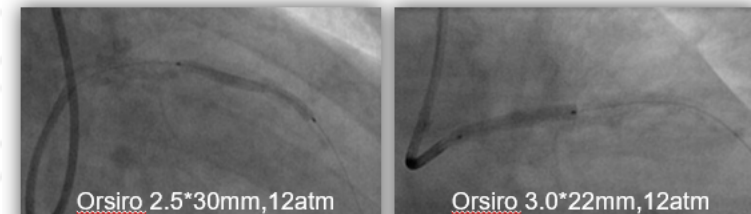
	C7-XR	IVUS
		
Axial Resolution	15 – 20 μm	100 – 200 μm
<p>Higher resolution is almost 10 times more Imaging core size is a half of that in IVUS</p>		
Max. Scan Dia.	10 mm	15 mm
<p>Scan area is smaller and penetration depth is more shallow</p>		
Lateral Sampling (3 mm Artery)	19 μm	225 μm
Blood Clearing	Required	Not Required

Case 8: OCT Role in LM ISR Lesion

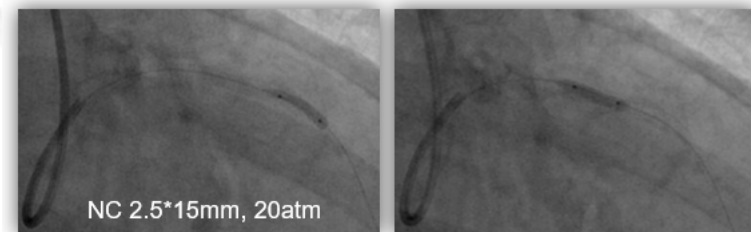
- 64 yo / ♀
- **NSTEMI**
- RF: DM (+), HL (+), SM (+)
- Echo: 41%, ant wall hypokinesia



2 BP-SESs w/ overlapping



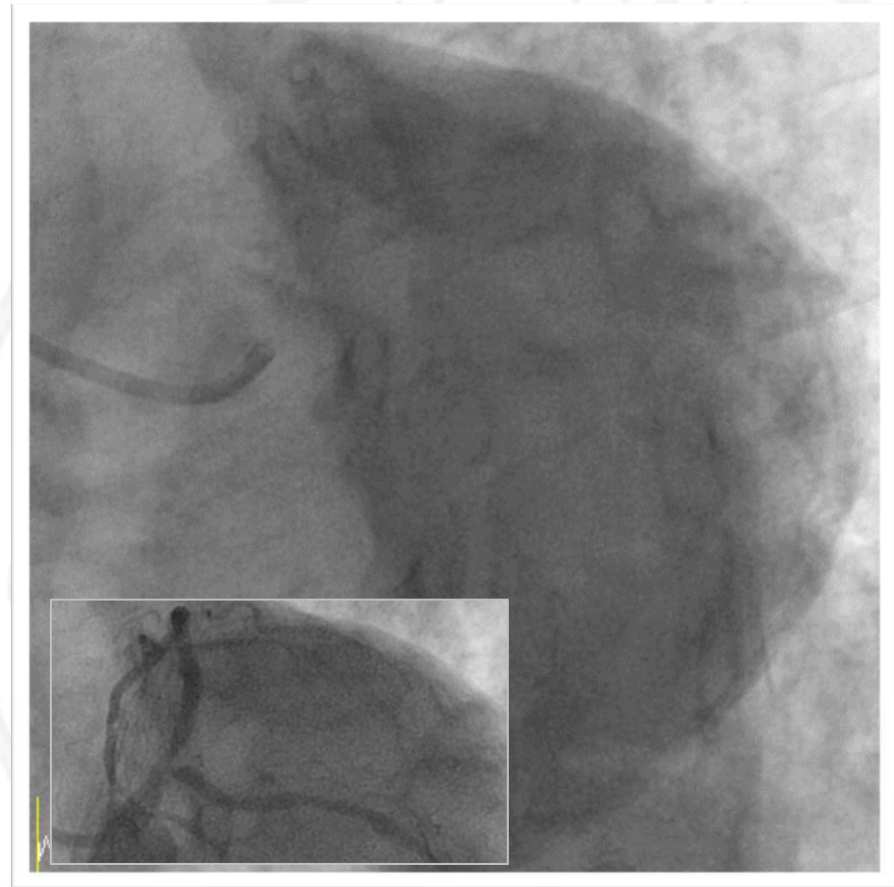
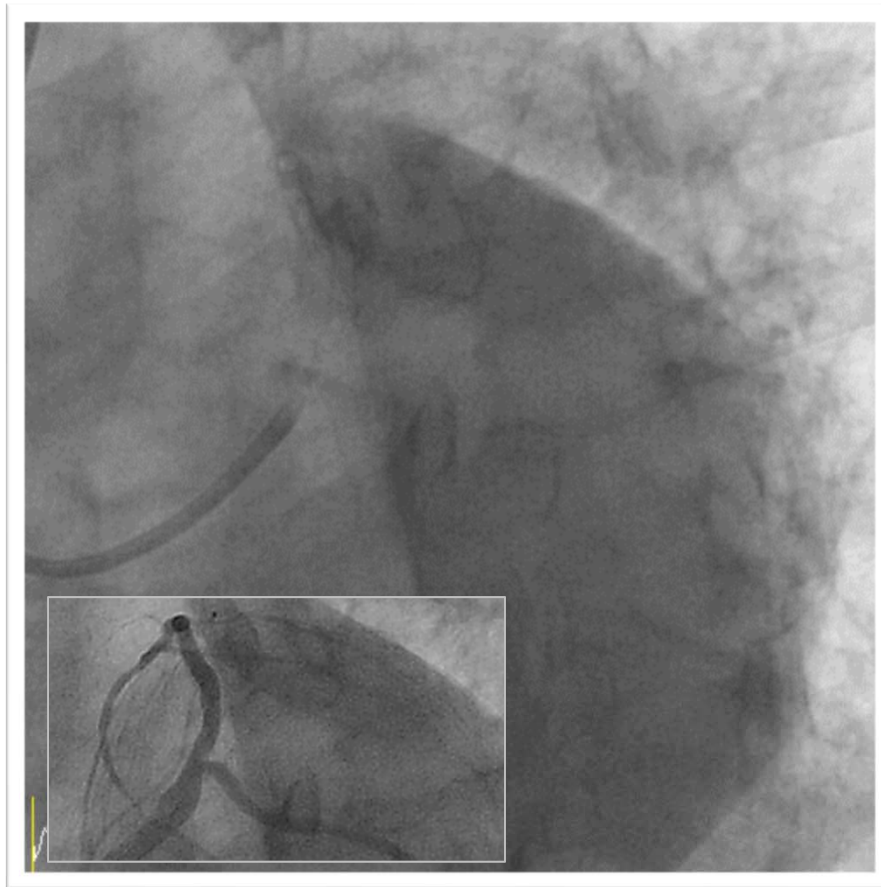
Post-dilatation



Comparison of 14M FU CAG vs. Final CAG

Final CAG @ index procedure

FU CAG @ 14 months dt SPECT (+)



- LMd to LADp: ISR type Ib
- LCX lesion: progression
- 14M FU SPECT: mild to mod. reversible perfusion defect in the apex, anterior and lateral wall

OCT Findings of LM-LAD ISR Lesion

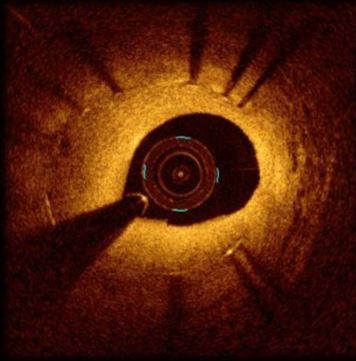
A. MLA (LAD os)

B. POC

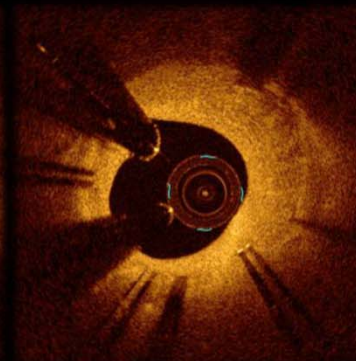
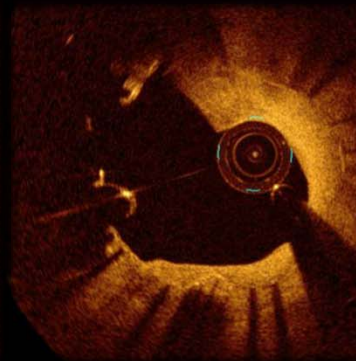
C. LM distal

D. prox. stent edge

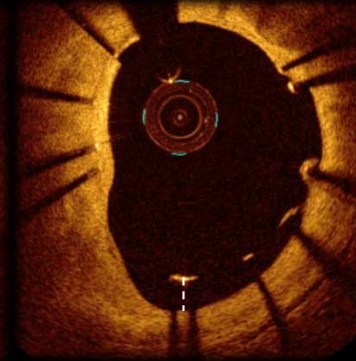
E. prox. ref. (LM)



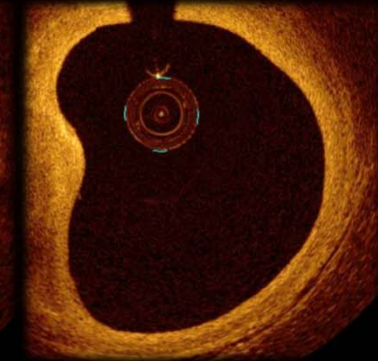
SA 5.03mm²
min/max D. 2.33/2.72mm
LA 1.81mm²
min/max D. 1.34 /1.69mm
%NIH 64.0%



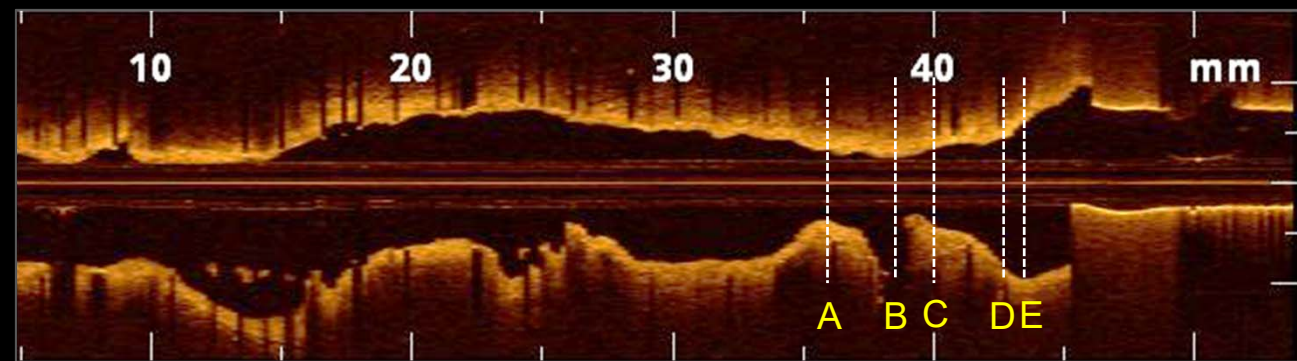
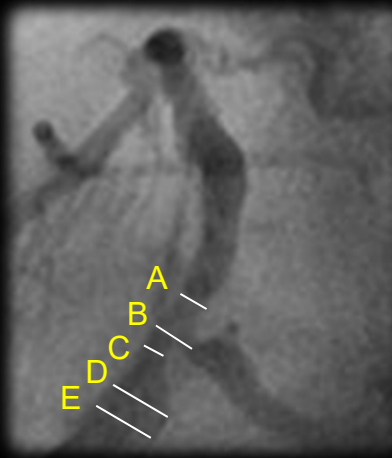
SA 4.52mm²
min/max D. 2.09/2.63mm
LA 2.22mm²
min/max D. 1.51/1.80mm
%NIH 50.9%



SA 6.61mm²
min/max D. 2.58/3.18mm
LA 7.47mm²
min/max D. 2.56/3.56mm
ISA depth 400µm



LA 10.23mm²
min/max D. 2.98/3.93mm



← distal

proximal →

OCT Findings of LM-LCX De novo Lesion

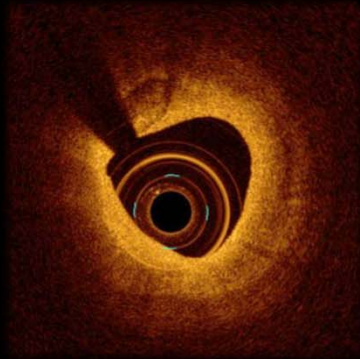
A. MLA (LCX os)

B. POC

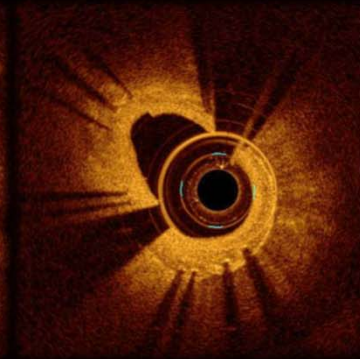
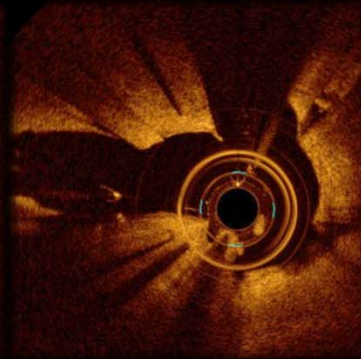
C. LM distal

D. prox. stent edge

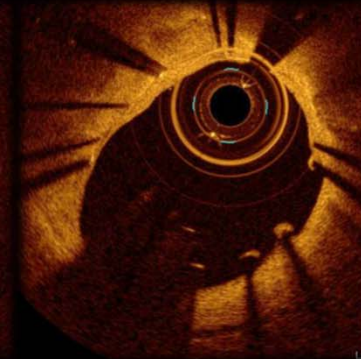
E. prox. reference



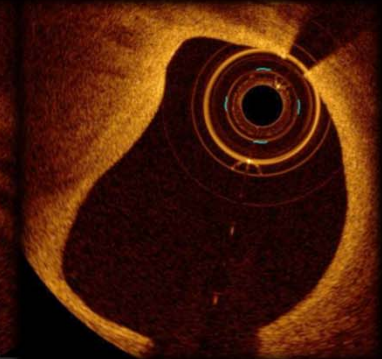
LA 2.26mm²
min/max D. 1.61/1.78mm



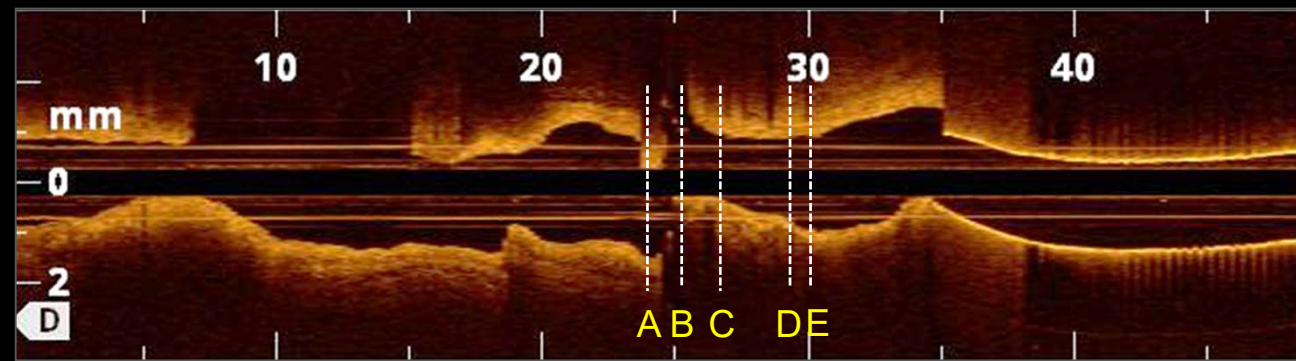
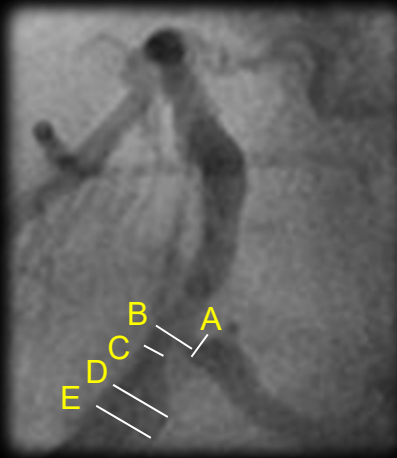
SA 2.89mm²
min/max D. 1.53/2.31mm
LA 1.65mm²
min/max D. 1.13/1.86mm
%NIH 42.9%



SA 5.56mm²
min/max D. 2.41/2.84mm
LA 6.24mm²
min/max D. 2.36/3.17mm



LA 9.96mm²
min/max D. 2.89/3.89mm

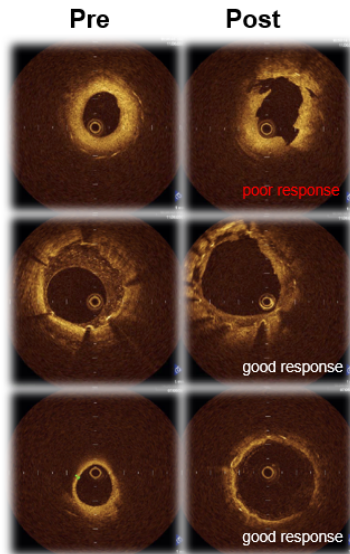


← distal

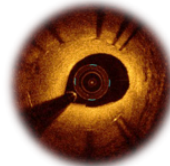
proximal →

Scoring Balloon Angioplasty followed by Drug-Coating Balloon Angioplasty for LM-LAD ISR

OCT-guided POBA for the Treatment of ISR



- OCT was a useful method for identifying the plaque tissue after DES implantation.
- Plaque with **heterogeneous** or **lipid-laden** pattern has **good** response to POBA, but that with **homogeneous** or **two layered** pattern has **poor** response.



MLA (LAD os)

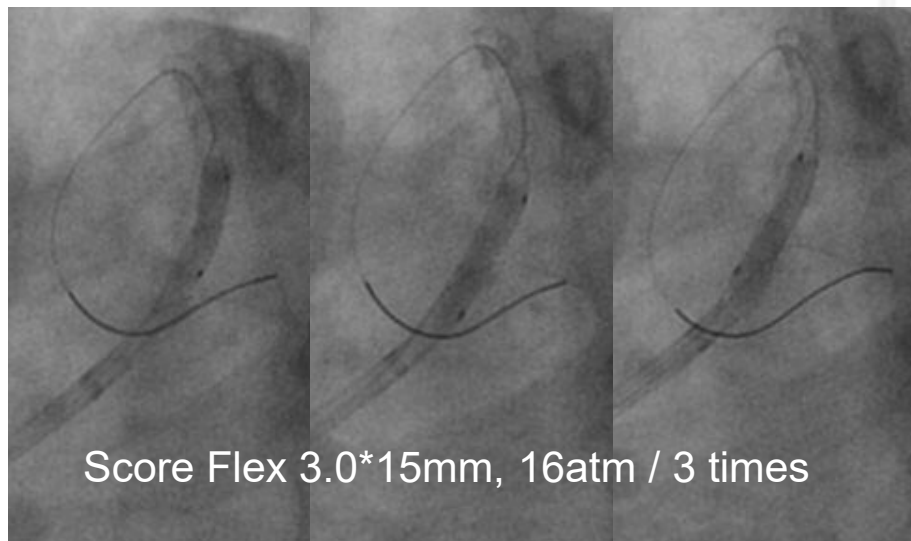
SA 5.03mm²
 min/max D. 2.33/2.72mm
 LA 1.81mm²
 min/max D. 1.34 /1.69mm
 %NIH 64.0%

Yamaguchi H. 2012 IPS

Score Flex Balloon

Features

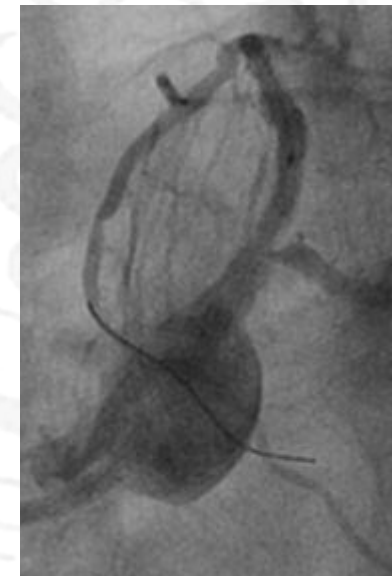
- Semi-Compliant
- 2.0mm - 4.0mm Diameters available
- Crossing profile 0.030" (3.0mm balloon)
- 10mm - 20mm Lengths available
- Guide wire exit port 11mm from distal tip
- 0.011" Nitinol integral wire with dual radiopaque markers
- X-Flex tip
- 139cm Shaft length



Score Flex 3.0*15mm, 16atm / 3 times



DCB
 3.5*20mm
 16 atm
 30 sec



OCT Findings Before and After Scoring Balloon and DCB Angioplasty

MLA (LAD os)

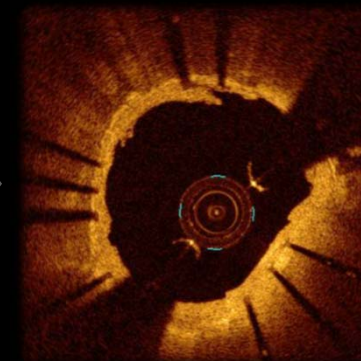
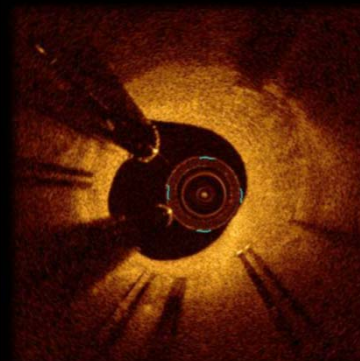
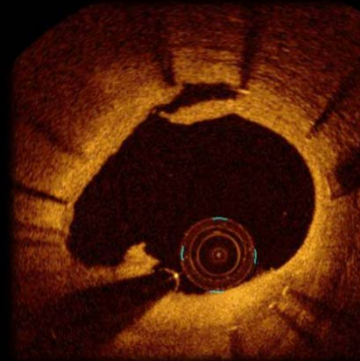
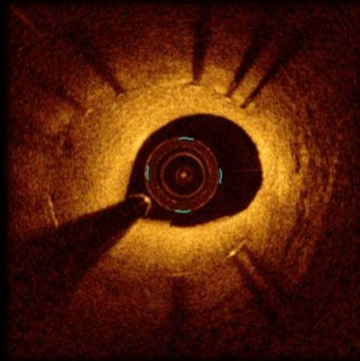
LM distal

before

after

before

after



SA 5.03mm²
LA 1.81mm²
%NIH 64.0%

SA 7.87mm²
LA 5.23mm²
%NIH 33.5%

SA 4.52mm²
LA 2.22mm²
%NIH 50.9%

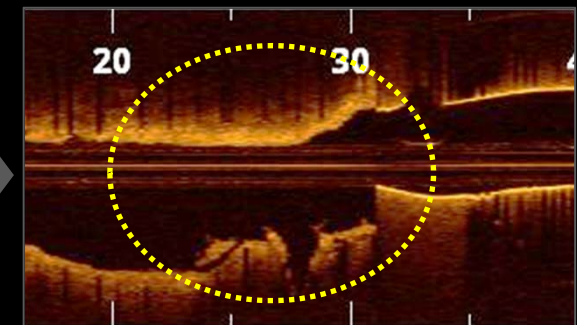
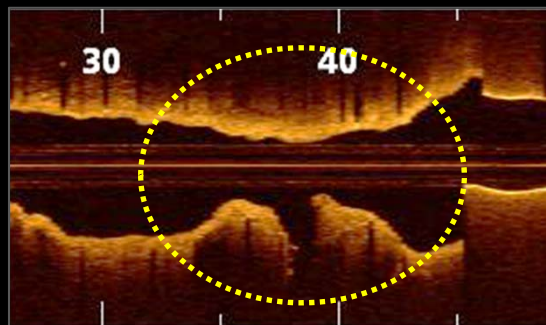
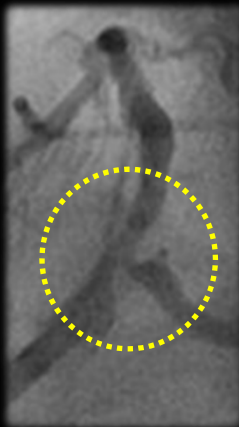
SA 5.94mm²
LA 5.08mm²
%NIH 14.5%

before

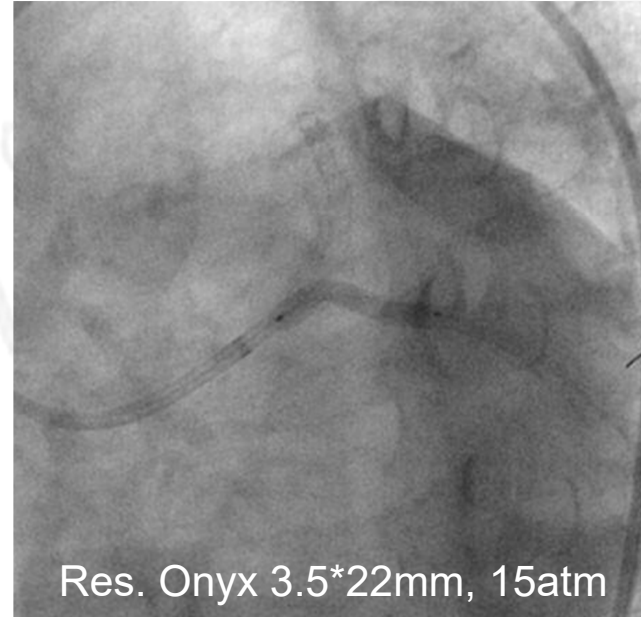
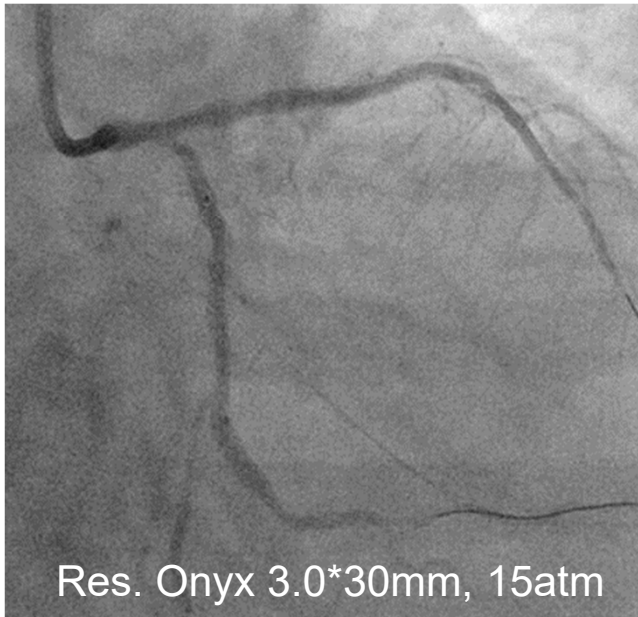
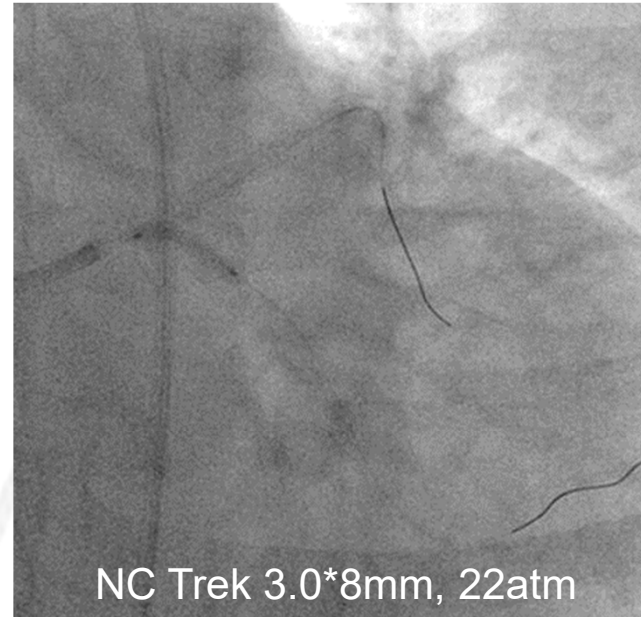
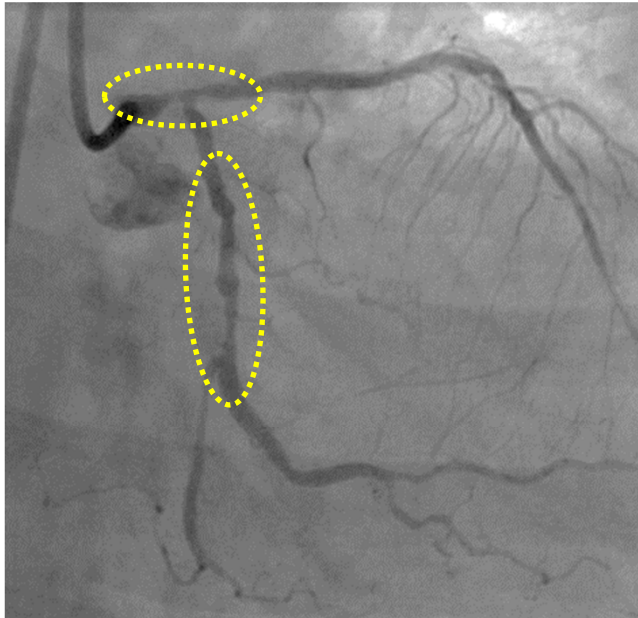
after

before

after

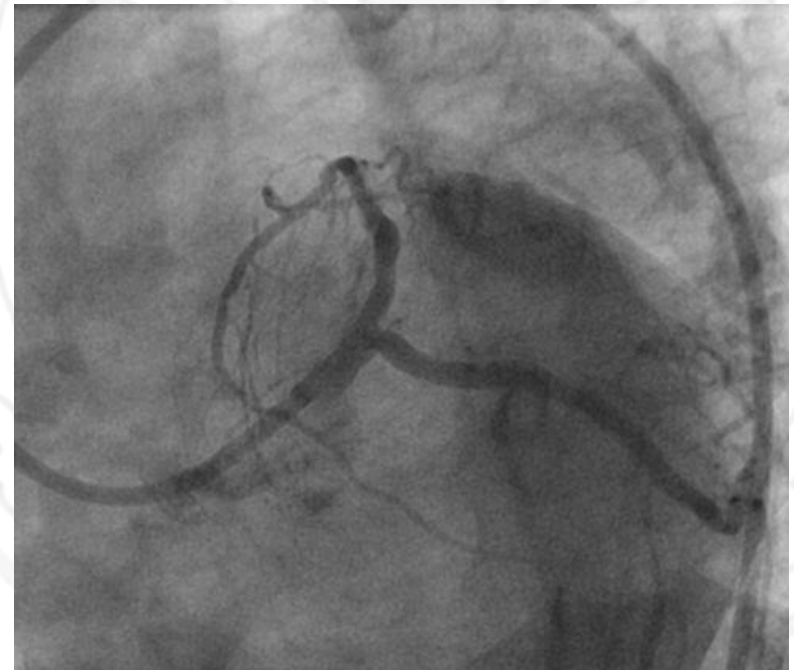
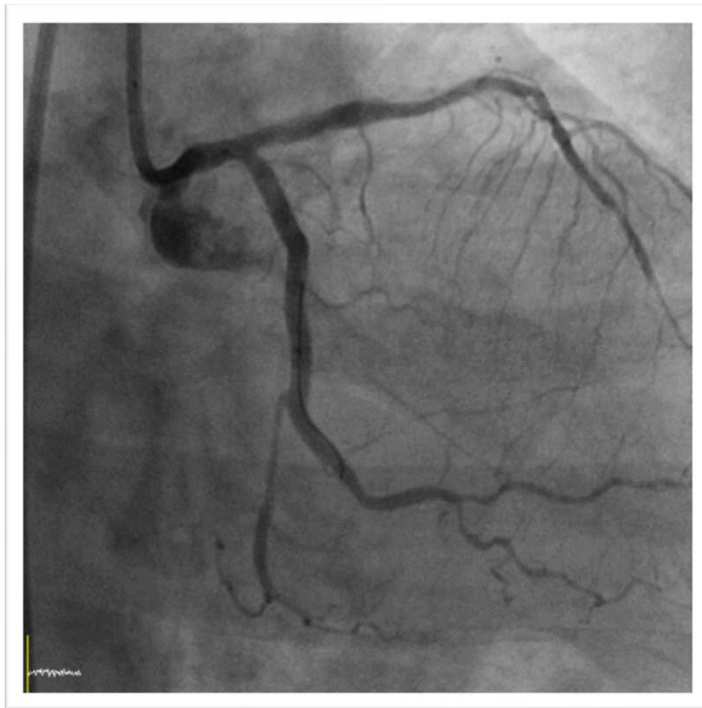
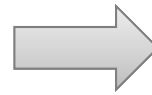
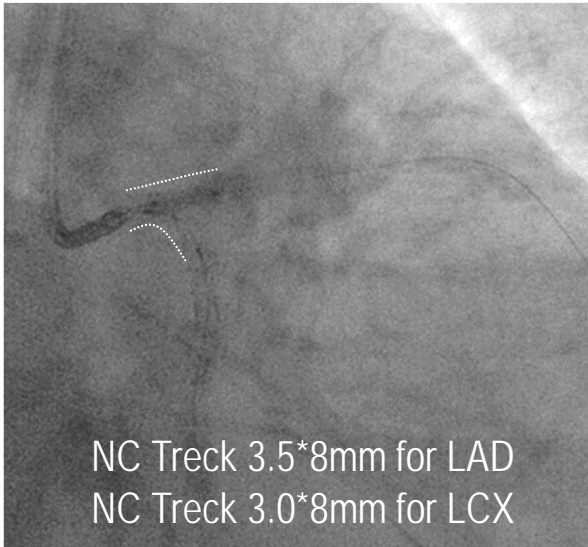


2 DES Implantation for LCX Lesion



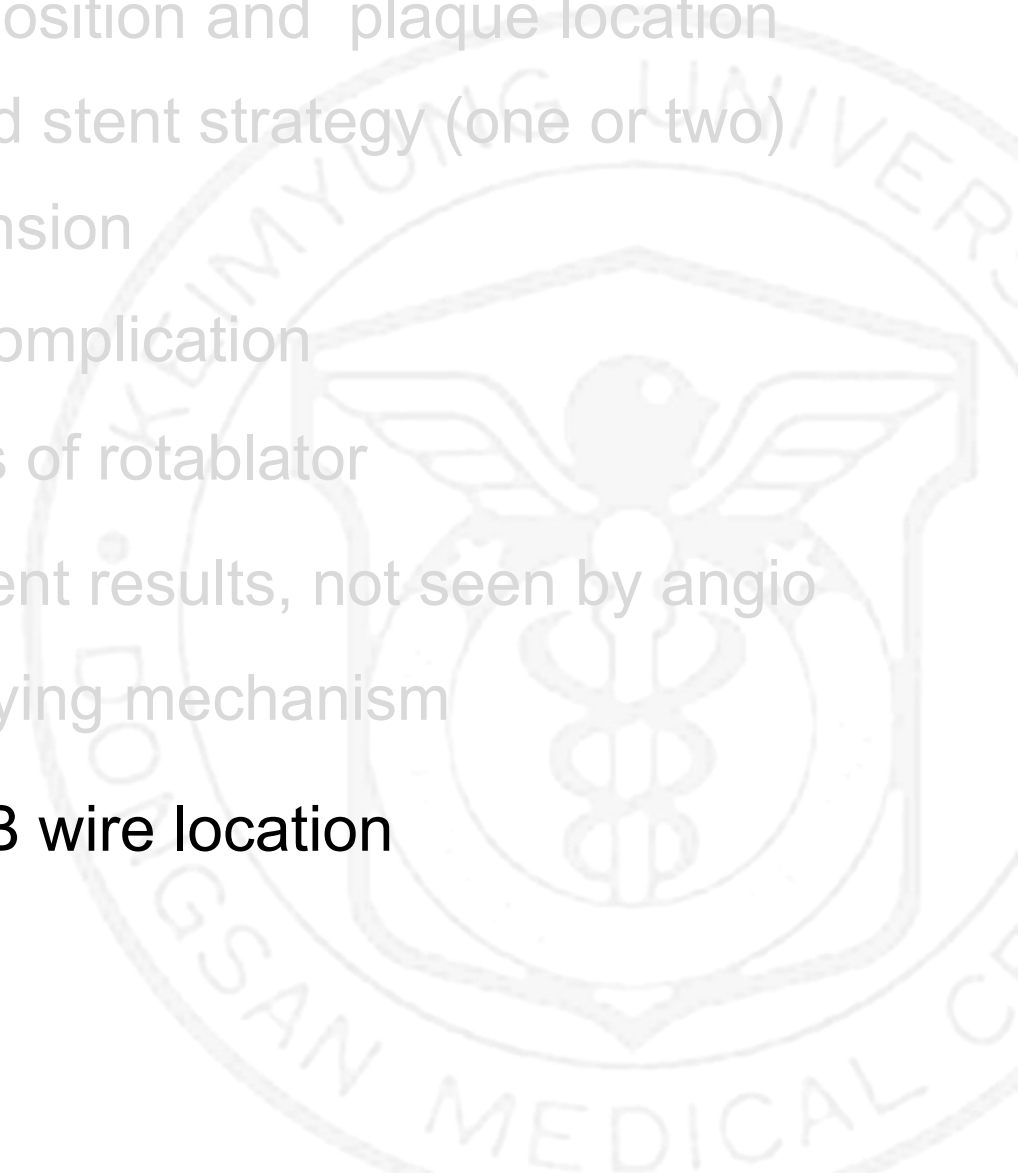
Case 8

FKB Inflation & Final CAG



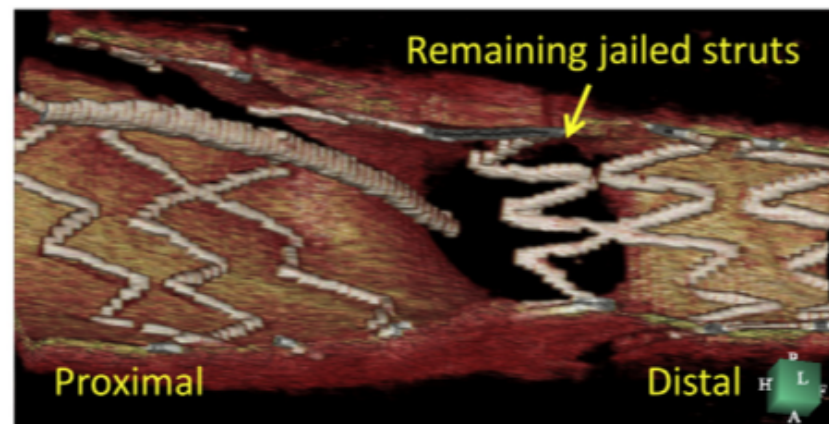
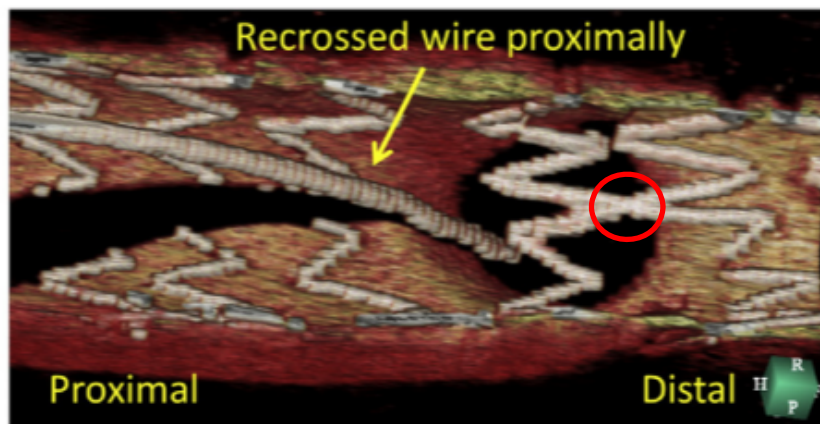
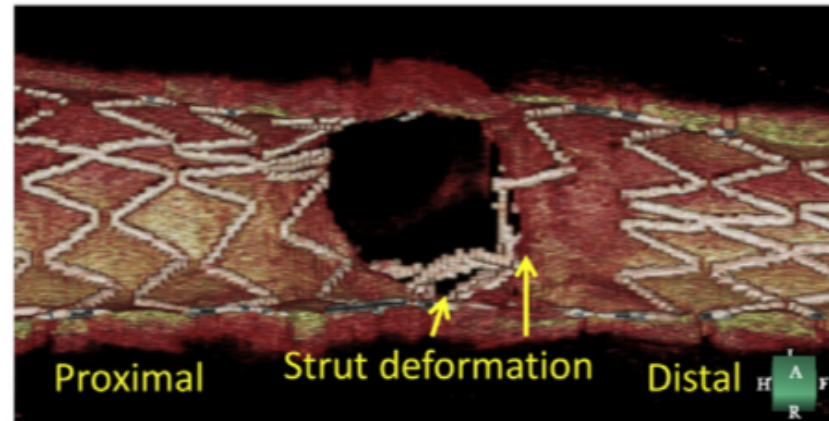
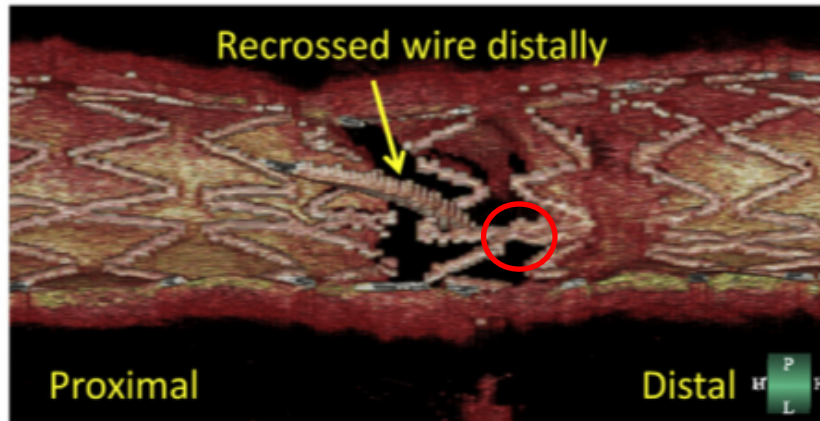
Role of Imaging Devices for Complex PCI

1. evaluation of plaque composition and plaque location
2. decision of stent sizing and stent strategy (one or two)
3. assessment of stent expansion
4. evaluation of procedural complication
5. evaluation of effectiveness of rotablator
6. detection of suboptimal stent results, not seen by angio
7. assessment of ISR underlying mechanism
8. evaluation of recrossed SB wire location

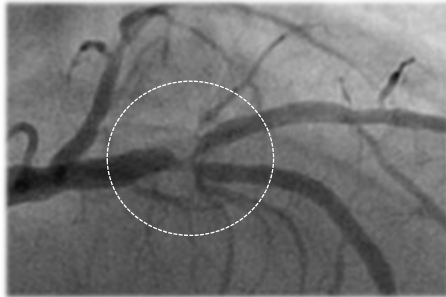


Evaluation of Guidewire Position in the SB

3D Reconstructed Image of Implanted Nobori Stent at the Bifurcation

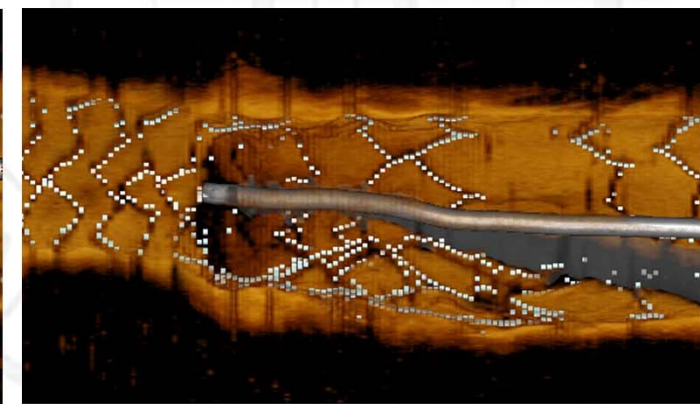
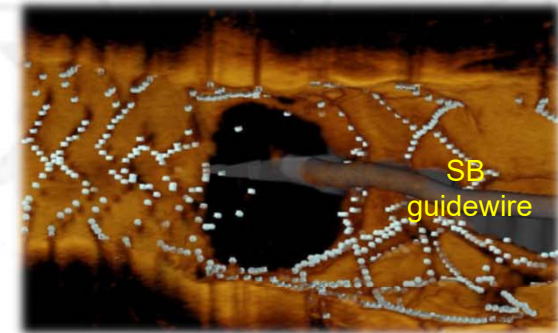
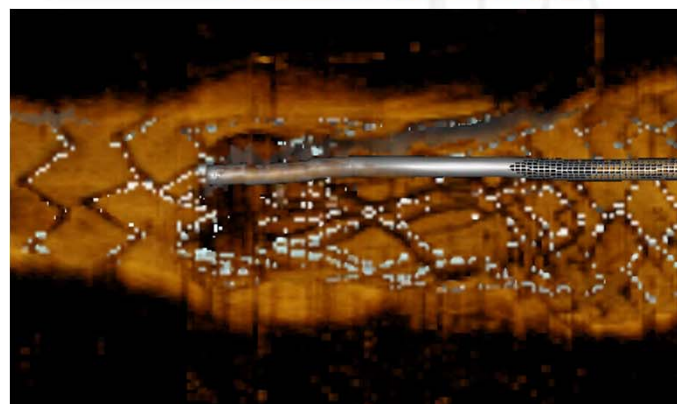


Case 9: OCT 3D Navigation in Bifur. PCI



- LAD / D1 bifurcation
- Medina (1.1.1)
- 2 Stents: Crushing
- Synergy 3.0*20mm
and 3.0*16mm

KUDH case

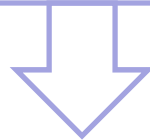


**Kissing
Balloon
Inflation**



Imaging Devices for Complex PCI Enable...

- evaluation of plaque composition and location in LM and bifurcation lesion
- decision for stent sizing and one- or two-stent strategy in LM and bifurcation lesion
- detection of wire complication and evaluation of stent optimization in CTO and long lesion
- evaluation of effectiveness of rotator in calcified lesion
- detection of suboptimal stent result, not seen by angio
- understanding of mechanisms (neointimal amount, characteristics and stent underexpansion) and decision for treatment strategy in ISR lesion
- evaluation of recrossed wire location and SB opening in bifurcation lesion



Impact of Intravascular Ultrasound-Guided Percutaneous Coronary Intervention on Long-Term Clinical Outcomes in Patients Undergoing Complex Procedures

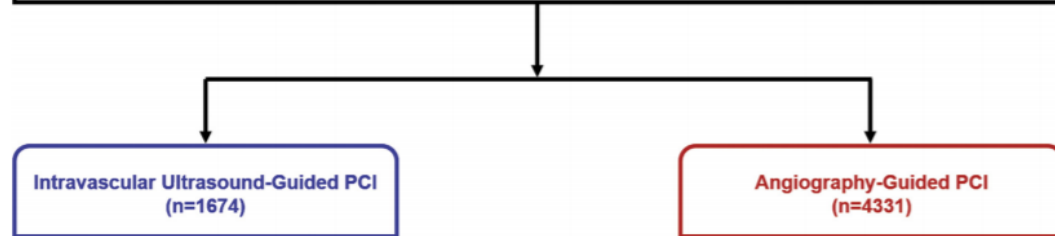
TABLE 2 Lesion and Procedural Characteristics in Patients With Complex Coronary Artery Lesions Undergoing PCI According to Use of Intravascular Ultrasound

	Intravascular Ultrasound-Guided (n = 1,674)	Angiography-Guided (n = 4,331)	p Value
Lesion characteristics			
Number of vessel disease			<0.001
1-vessel disease	501 (29.9)	1,110 (25.6)	
2-vessel disease	758 (45.3)	1,824 (42.1)	
3-vessel disease	415 (24.8)	1,397 (32.3)	
Multivessel disease	1,273 (70.1)	3,221 (74.4)	0.001
Lesion location (per vessel)			
LM	453 (27.1)	231 (5.3)	<0.001
LAD	1,406 (84.0)	3,417 (78.9)	<0.001
LCX	842 (50.3)	2,679 (61.9)	<0.001
RCA	701 (41.9)	2,719 (62.8)	<0.001
Number of lesion (per patient)	2.8 ± 1.6	2.9 ± 1.6	0.001
SYNTAX score	17.7 ± 9.4	16.9 ± 9.8	0.021
Pre-PCI diameter stenosis, %	83.9 ± 11.1	88.0 ± 10.0	<0.001
Post-PCI diameter stenosis, %	3.8 ± 11.1	8.7 ± 19.4	<0.001
Total lesion length, mm	39.7 ± 28.0	37.1 ± 23.1	0.001
Procedural characteristics			
Angiographic success	1,650 (98.6)	4,123 (95.2)	<0.001
Fluoroscopy time, min	25.1 ± 17.4	20.4 ± 15.2	<0.001
Contrast volume, ml	235.4 ± 95.8	207.3 ± 80.9	<0.001
Transradial approach	1,167 (69.7)	3,312 (76.5)	<0.001
Type of stent			0.004
First-generation drug-eluting stent	806 (48.1)	1,903 (43.9)	
Second-generation drug-eluting stent	868 (51.9)	2,428 (56.1)	
Implanted stent number	1.9 ± 1.0	1.7 ± 0.9	<0.001
Mean stent diameter, mm	3.2 ± 0.4	3.0 ± 0.4	<0.001
Minimal stent diameter ≥3 mm	1,121 (67.0)	2,095 (48.4)	<0.001
Total stent length, mm	46.2 ± 26.8	44.3 ± 24.4	0.014
Maximum balloon pressure, mm Hg	16.0 ± 3.1	14.8 ± 3.7	<0.001
Adjunctive balloon dilatation	820 (49.0)	777 (17.9)	<0.001
Timing of intravascular ultrasound use	1,674 (100)	0 (0)	<0.001
Pre- and post-stent	1,314 (78.5)		
Pre-PCI only	120 (7.2)		
Post-stent only	240 (14.3)		

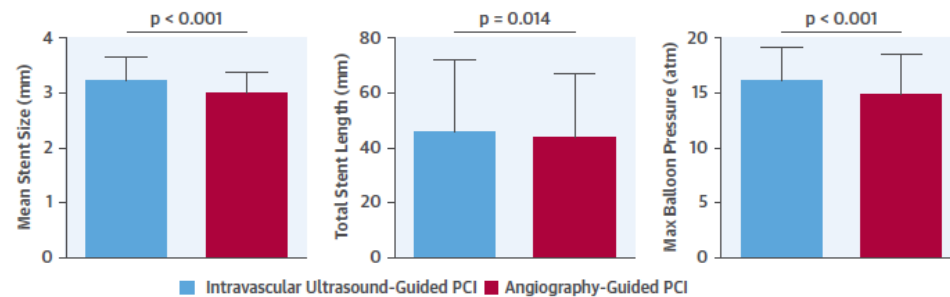
6005 Patients who have a complex coronary artery lesion undergoing PCI with DES

*** Definition of complex lesions**

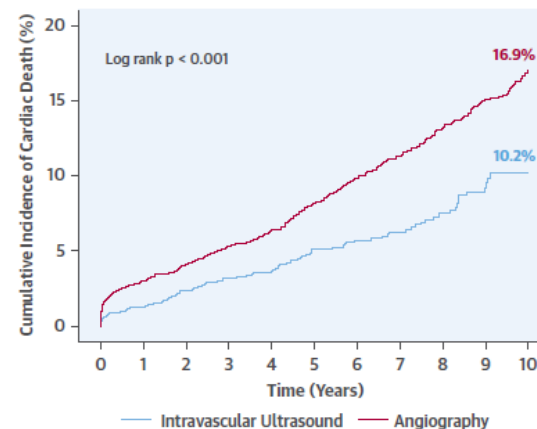
- ① Bifurcation lesion with side branch ≥2.5mm size
- ② Chronic total occlusion (≥3 months) as target lesion
- ③ PCI for unprotected left main disease
- ④ Implanted stent length ≥38mm
- ⑤ Multi-vessel PCI (≥2 vessels treated at one PCI session)
- ⑥ Multiple stent needed (≥3 stents per patient)
- ⑦ In-stent restenosis lesion as target lesion
- ⑧ Severely calcified lesion (using rotablation)



Procedural Factors



Clinical Outcomes



Lesion Type	OR (95% CI)
All Lesion	0.573 (0.460-0.714)
Bifurcation Lesion	0.682 (0.498-0.934)
Chronic Total Occlusion Lesion	0.670 (0.408-1.102)
Left Main Disease	0.203 (0.126-0.329)
Long Lesion	0.602 (0.450-0.804)
Multi-Vessel PCI	0.639 (0.473-0.864)
Multiple Stents Implantation	0.532 (0.332-0.855)
In-Stent Restenosis Lesion	0.837 (0.403-1.740)
Calcified Lesion	0.458 (0.052-4.012)

0.01 0.1 1 10
Favors Intravascular Ultrasound Favors Angiography

CONCLUSION

A photograph of Barack Obama speaking at a podium, overlaid with a dark blue semi-transparent rectangle containing white text. The background of the photo is a blurred American flag.

If you're walking
down the right path...
eventually you'll
make progress

Barack Obama

Thank you for kind attention

A large, faint watermark of a circular seal is visible in the background. The seal contains the text 'R/VA' at the top, 'MEDICAL CENTER' at the bottom, and 'U.S.A.' in the center.