Drill and shock

Treatment of a tight calcified lesion by rotational atherectomy followed by coronary intravascular lithotropsy

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Vignette

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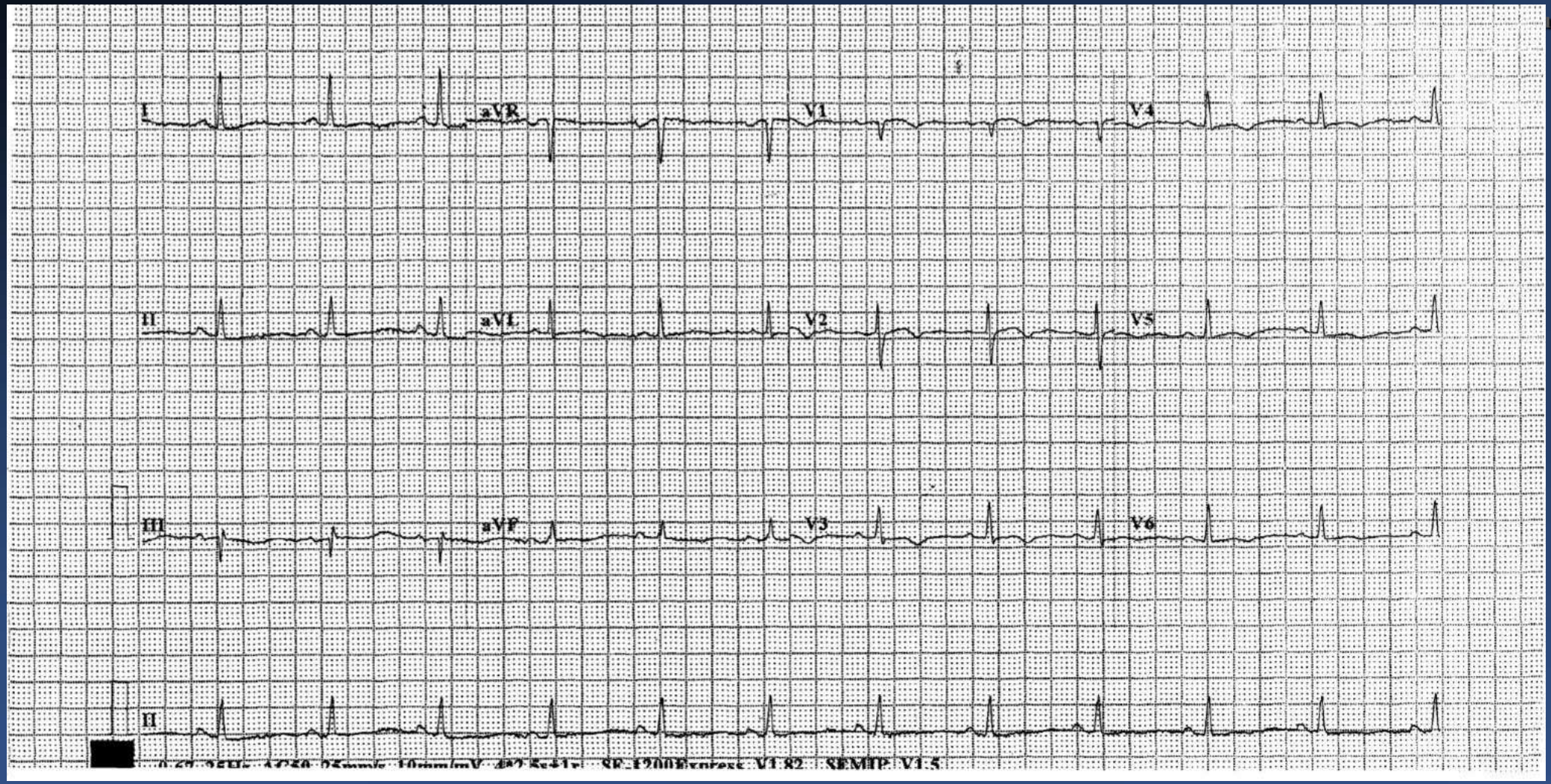
67 year old women, ex- smoker
HT on amlodipine and losartan
Hyperlipidemia on atorvastatin.
Suboptimal drug compliance
Occasional atypical chest pain in past 2 year
New-onset CCS IV angina for 3 days
P/E:
BP/P stable
Heart sound dual. No murmur
Killip class I



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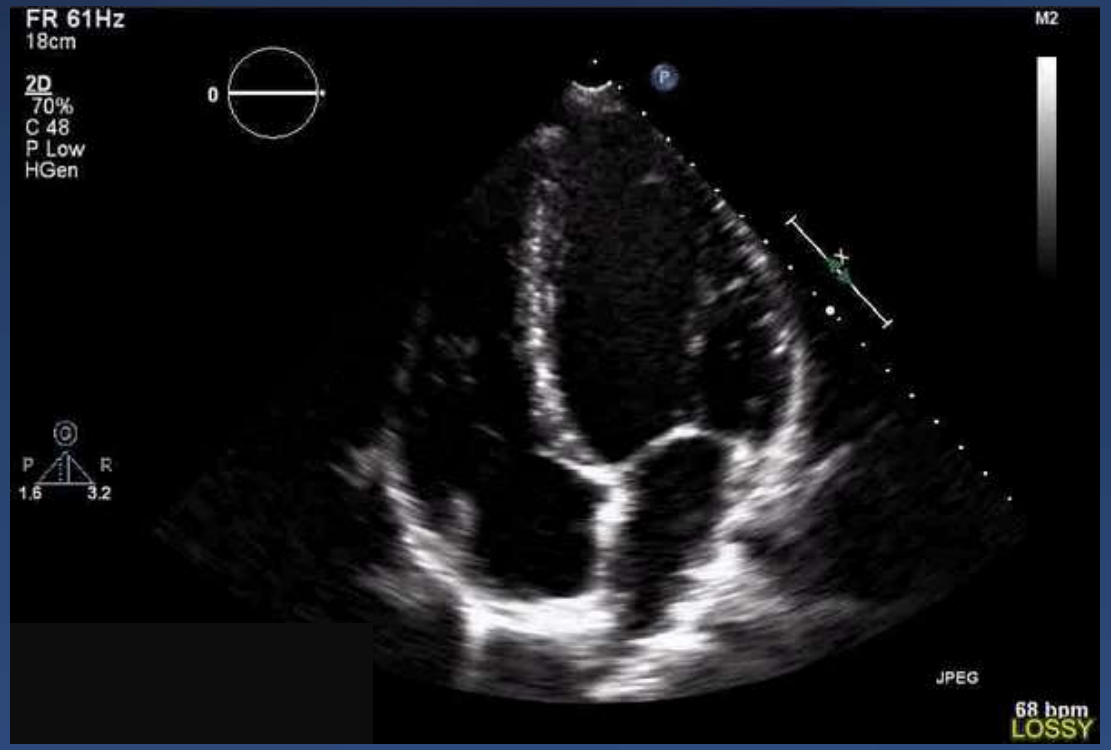
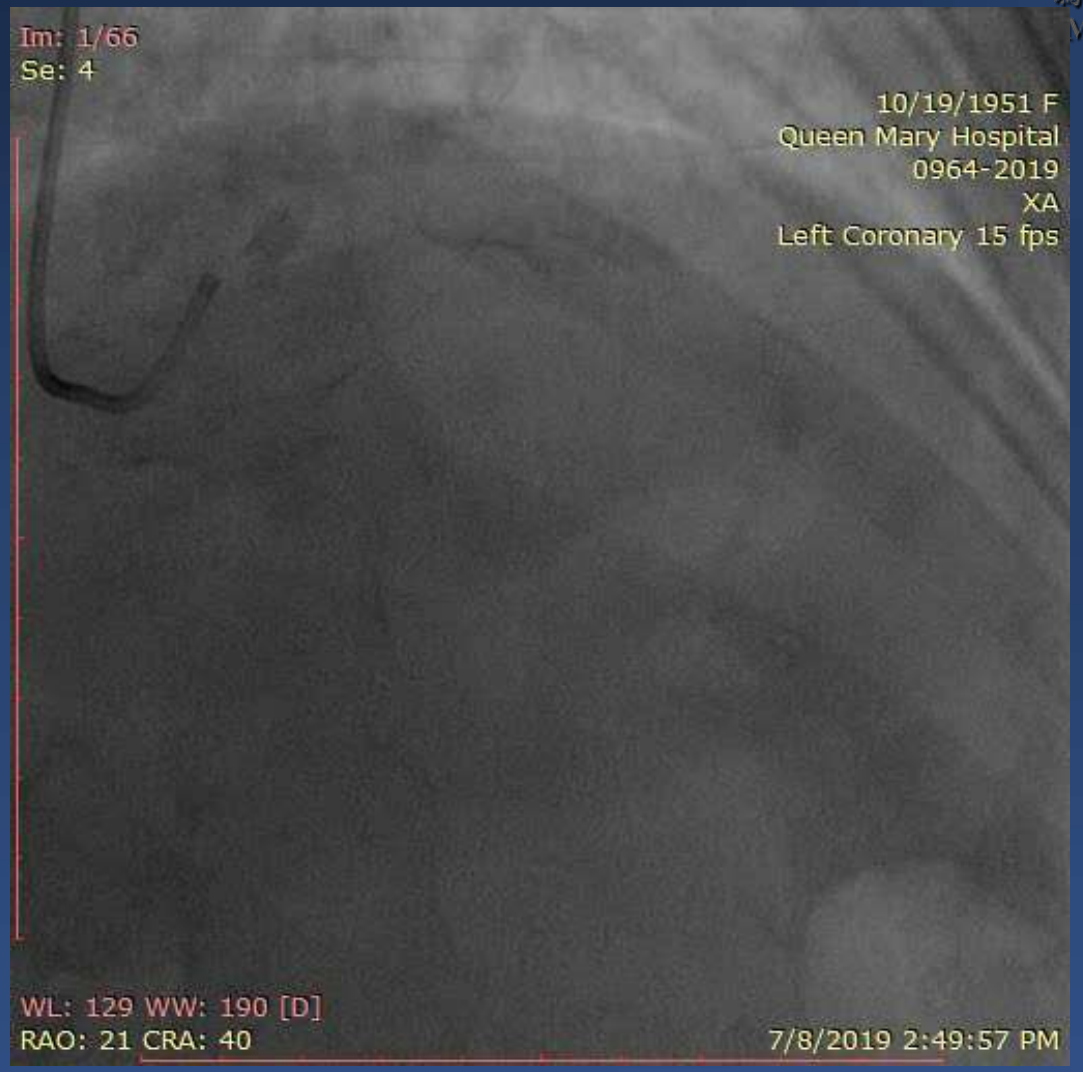


Investigation and treatment

- Troponin: normal
- Blood count, renal/liver function, clotting profile unremarkable

- Treated as NSTE-ACS (UA)
  - Load DAPT (ASA + ticagrelor), Low molecular weight heparin, started carvedilol. Increased Atorvastatin 40mg daily.



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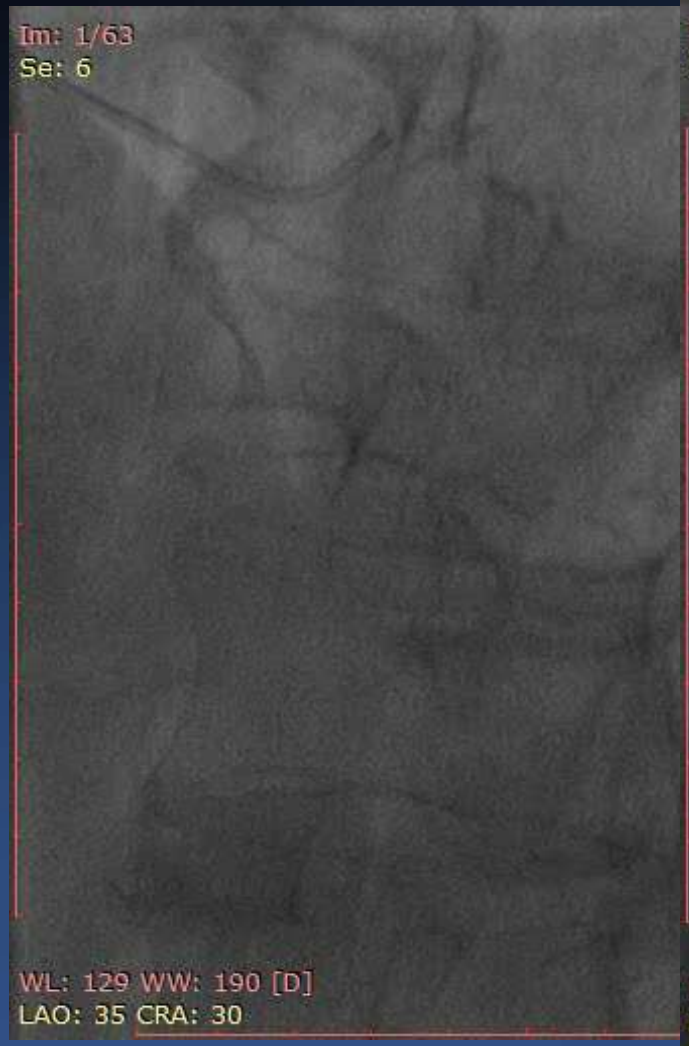
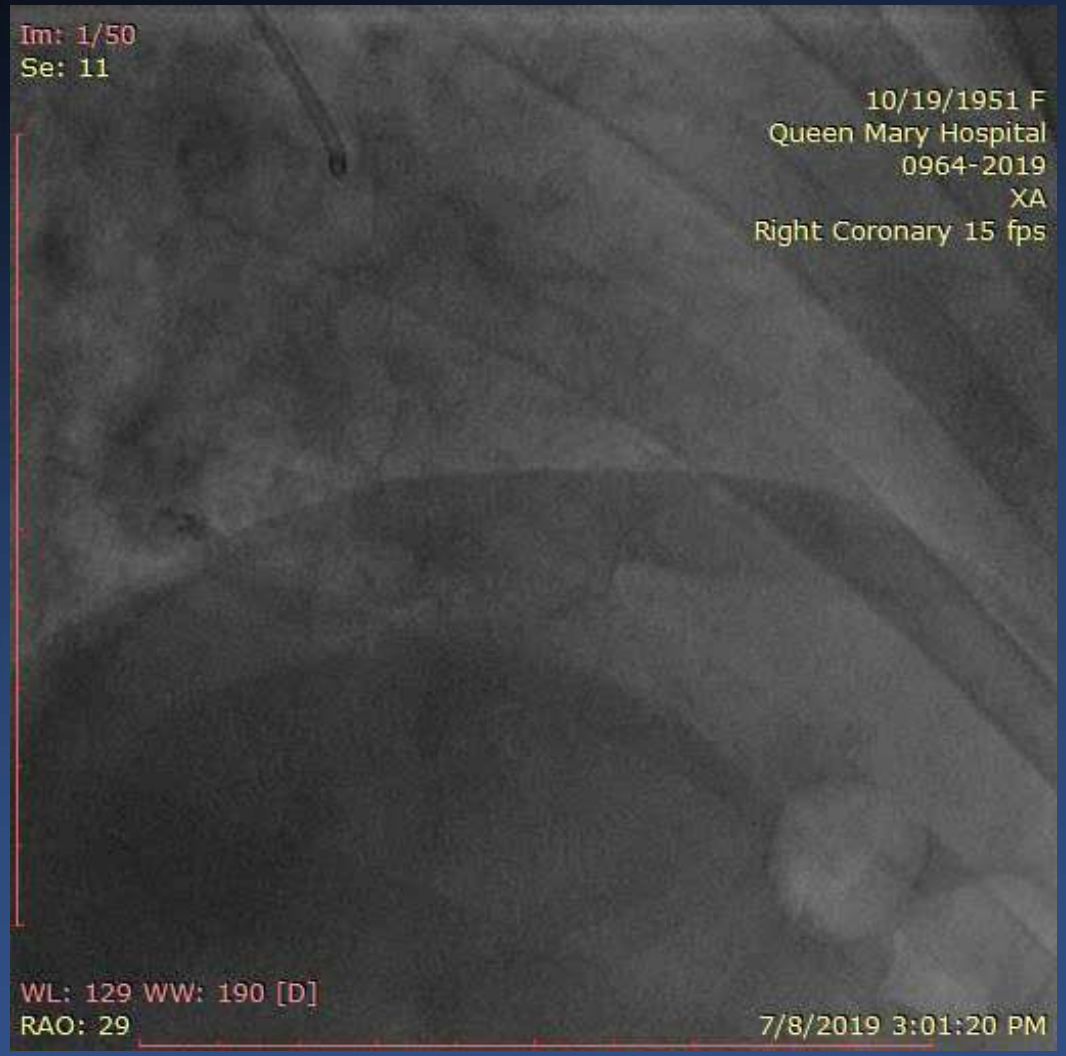
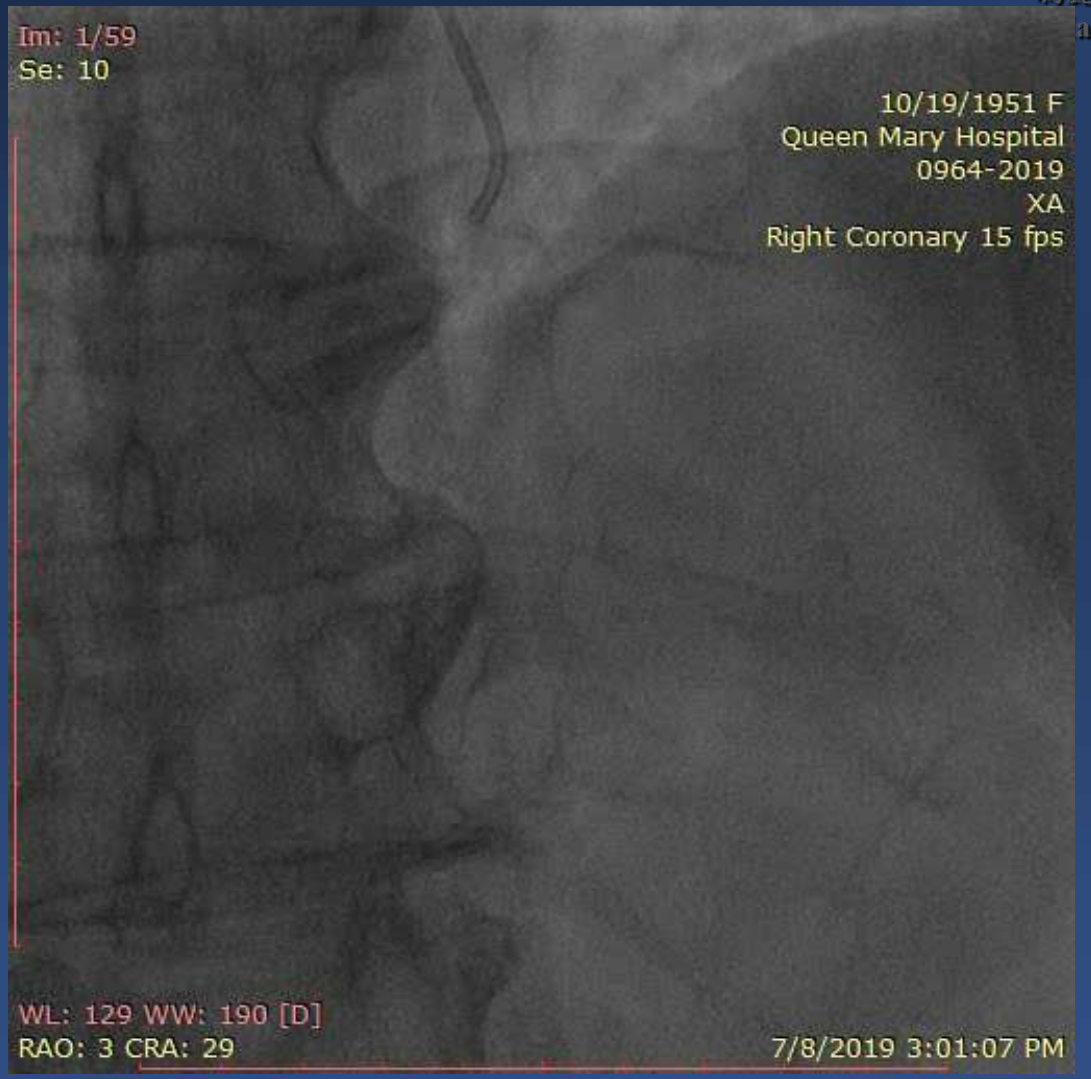

Im: 1/63
Se: 6
WL: 129 WW: 190 [D]
LAO: 35 CRA: 30


Im: 1/114
Se: 7
WL: 129 WW: 190 [D]
LAO: 21 CAU: 37


Im: 1/124
Se: 8
10/19/1951 F
Queen Mary Hospital
0964-2019
XA
Left Coronary 15 fps
WL: 129 WW: 190 [D]
RAO: 1 CAU: 42
7/8/2019 2:54:06 PM





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PROCEDURE

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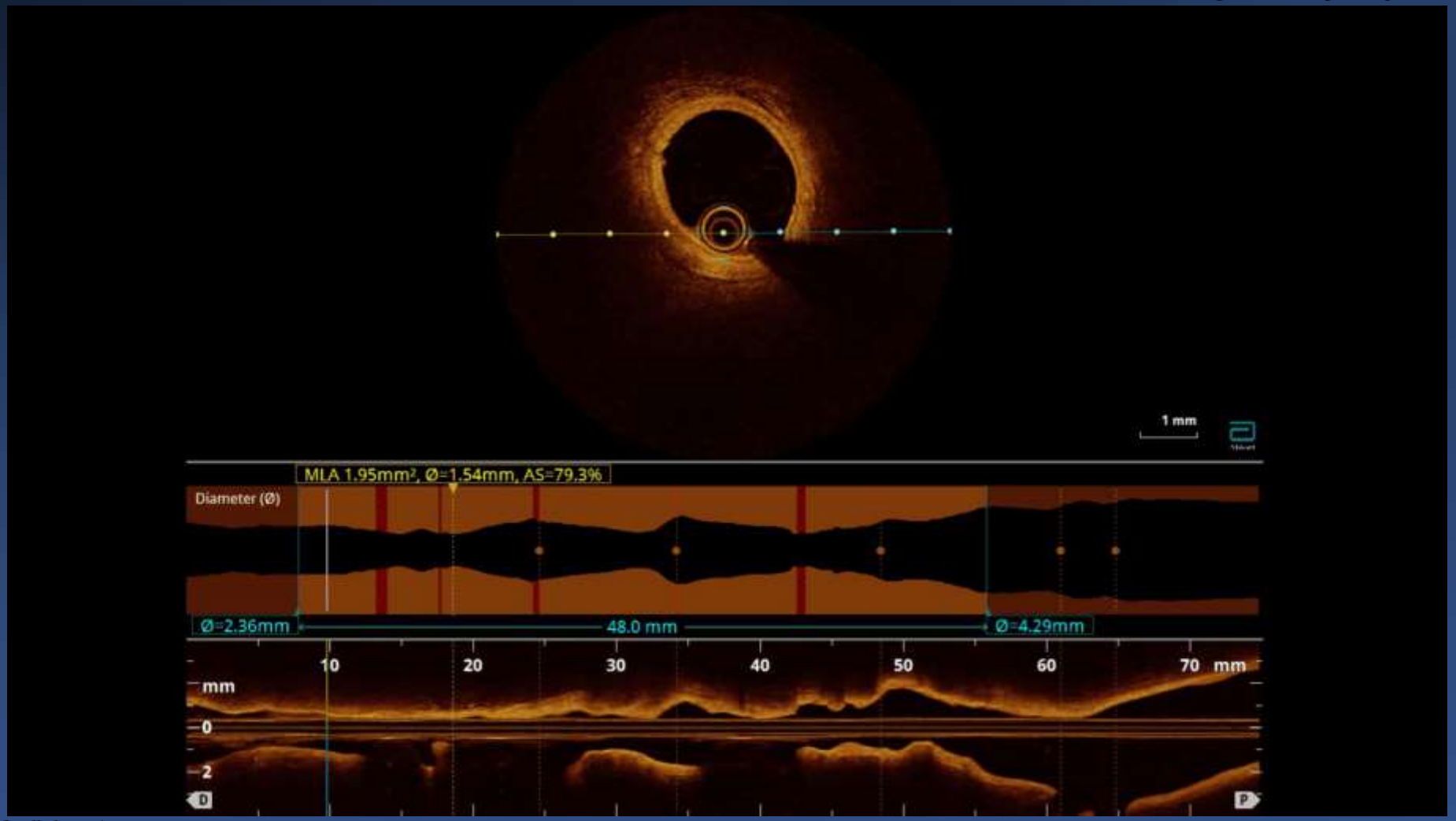
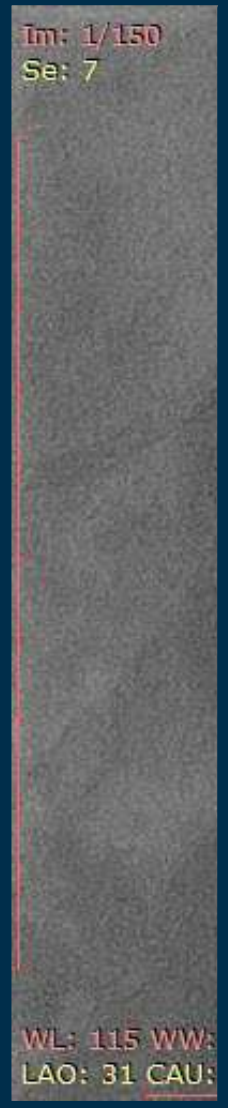
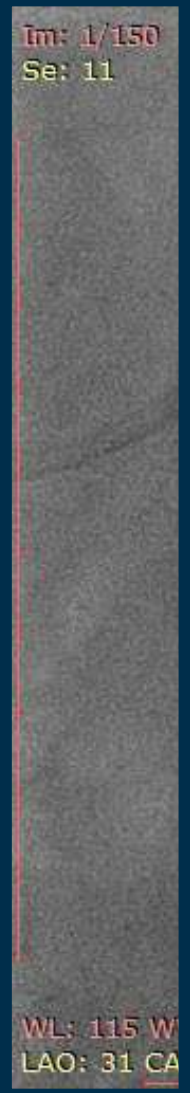
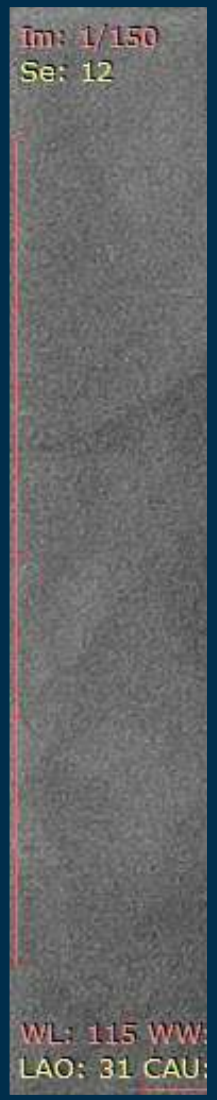
7 Fr, right femoral access. EBU 3.6 guiding cathether. Runthrough HC guidewire to LAD
OCT to LAD showed severe concentric calcified lesion and mLAD, large vessel size.
Wire to LCx, unable to advance OCT die to tight pLCx lesion.



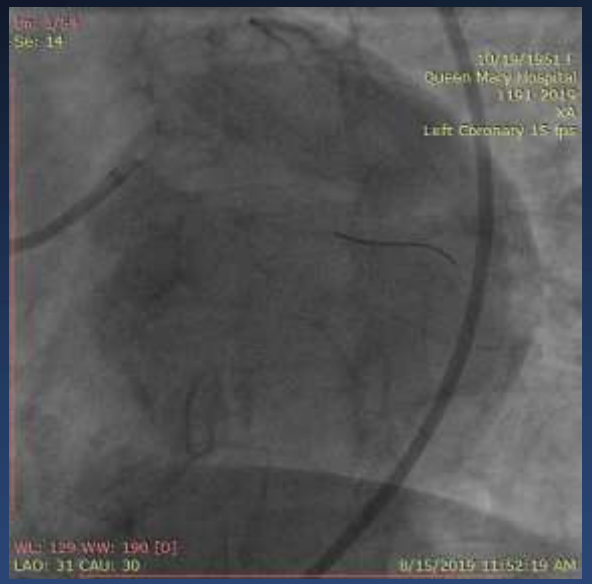


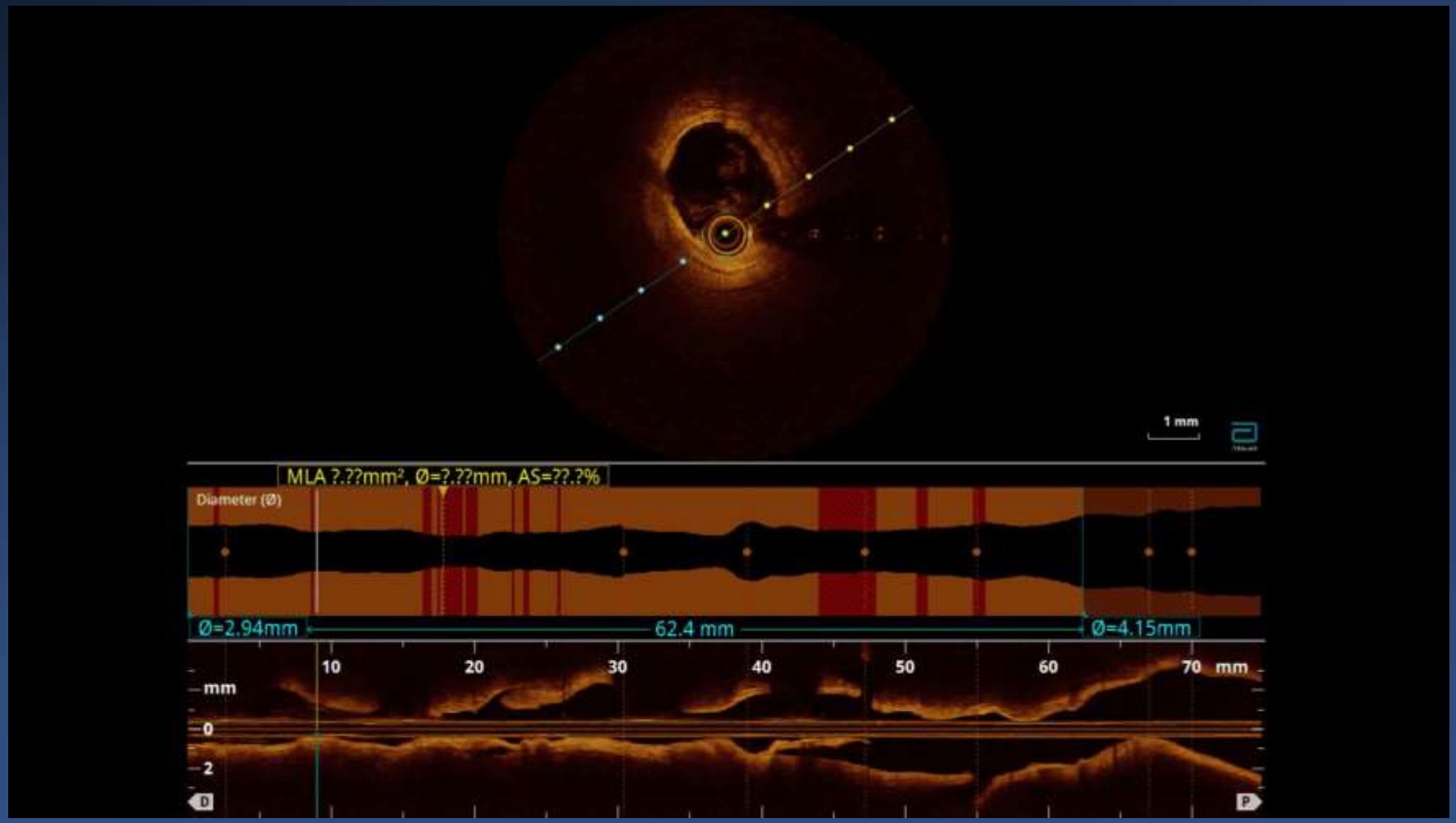




Rotation done with Rotawire floppy on Finecross MC and 1.5 burr at 185,000 rpm with 6 passes

OCT showed Calcified plaque extending to LM with intramural hematoma. Thick calcified plaque at ostial LCx






A Area: 3.97mm²
Mean Diameter: 2.22mm
Min: 1.77mm Max: 2.70mm
29-AUG-2019 3:22:47 PM
0001
1 mm


A Area: 2.48mm²
Mean Diameter: 1.77mm
Min: 1.65mm Max: 1.89mm
29-AUG-2019 3:06:12 PM
0001
1 mm


A Area: 2.41mm²
Mean Diameter: 1.71mm
Min: 1.28mm Max: 2.28mm
29-AUG-2019 3:06:12 PM
0001
1 mm


A Area: 4.90mm²
Mean Diameter: 2.45mm
Min: 1.92mm Max: 3.14mm
29-AUG-2019 3:22:48 PM
0001
1 mm


A Area: 2.80mm²
Mean Diameter: 1.85mm
Min: 1.44mm Max: 2.38mm
29-AUG-2019 3:06:13 PM
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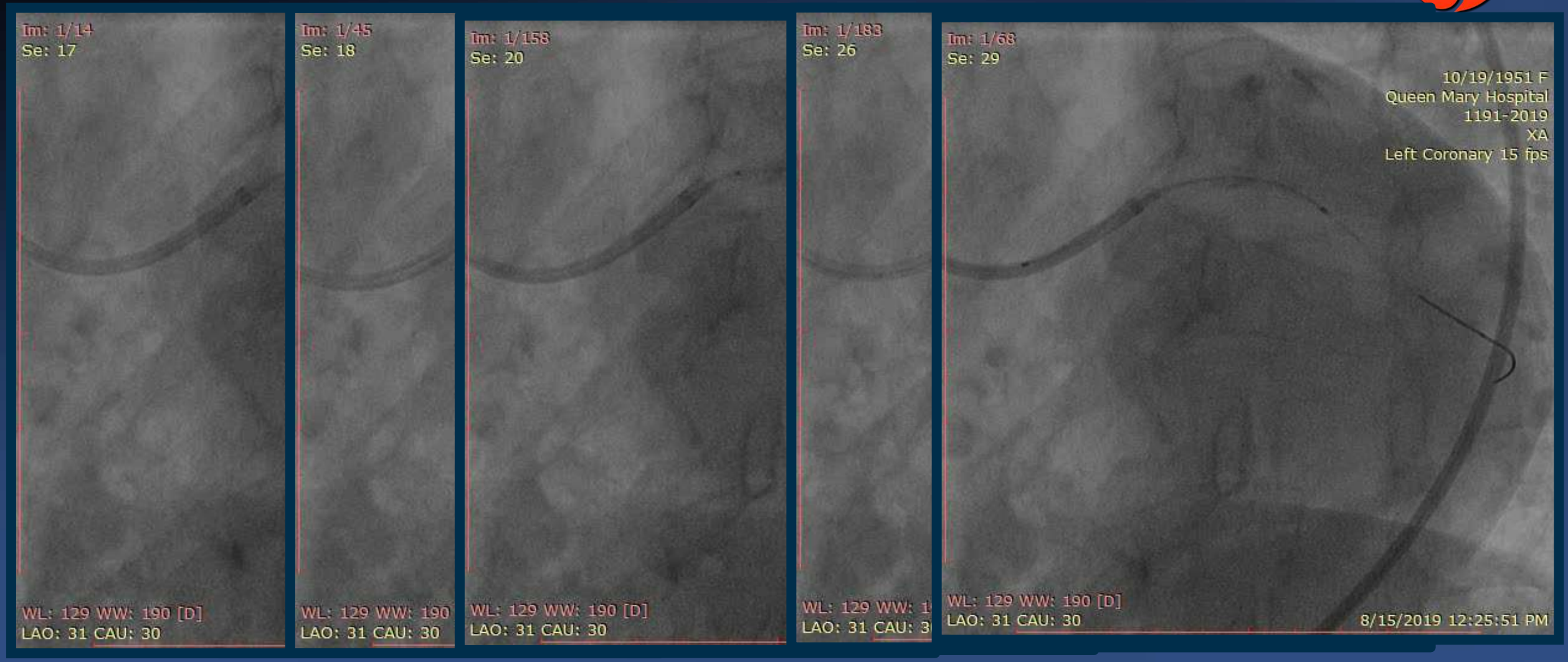
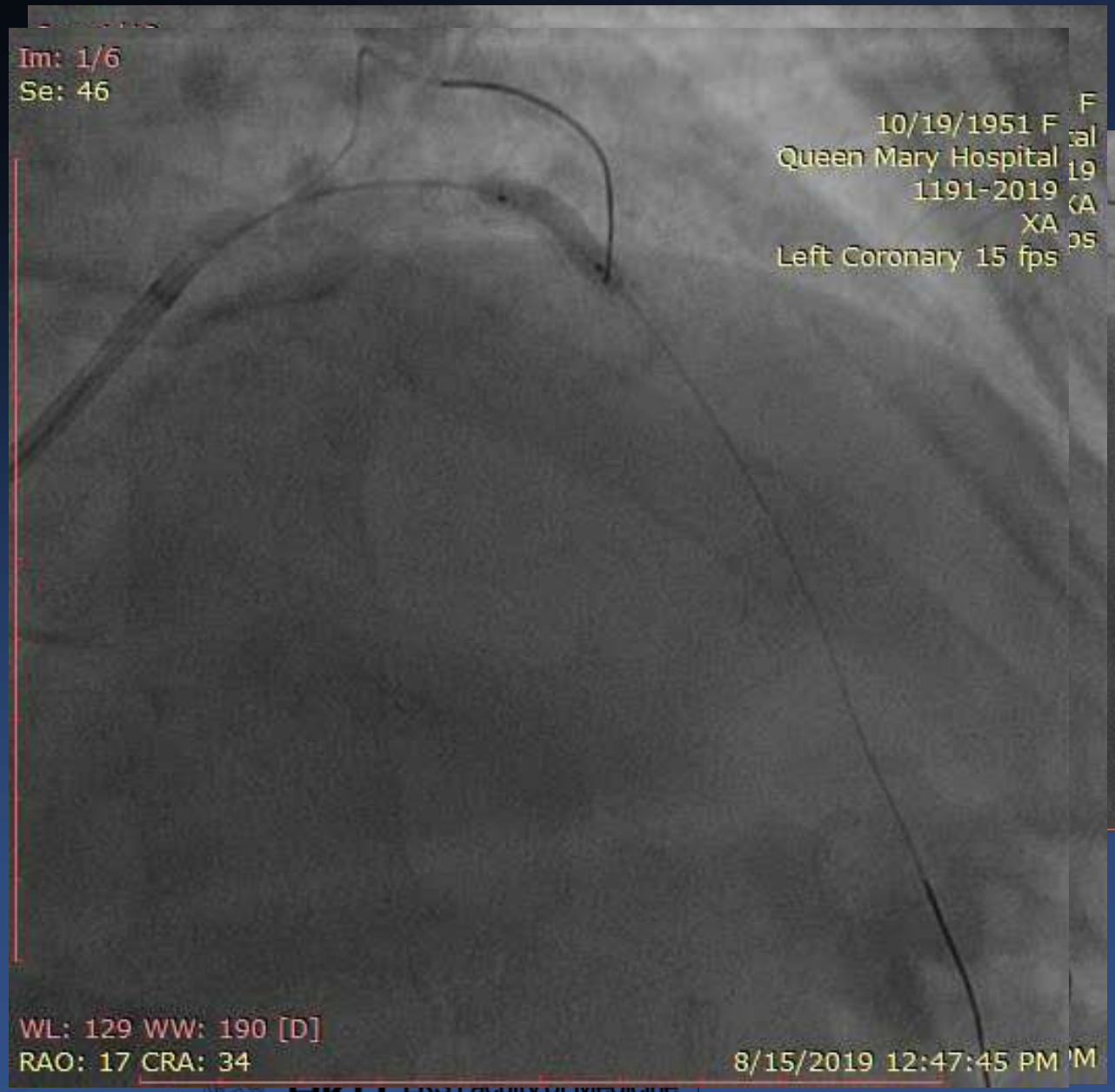
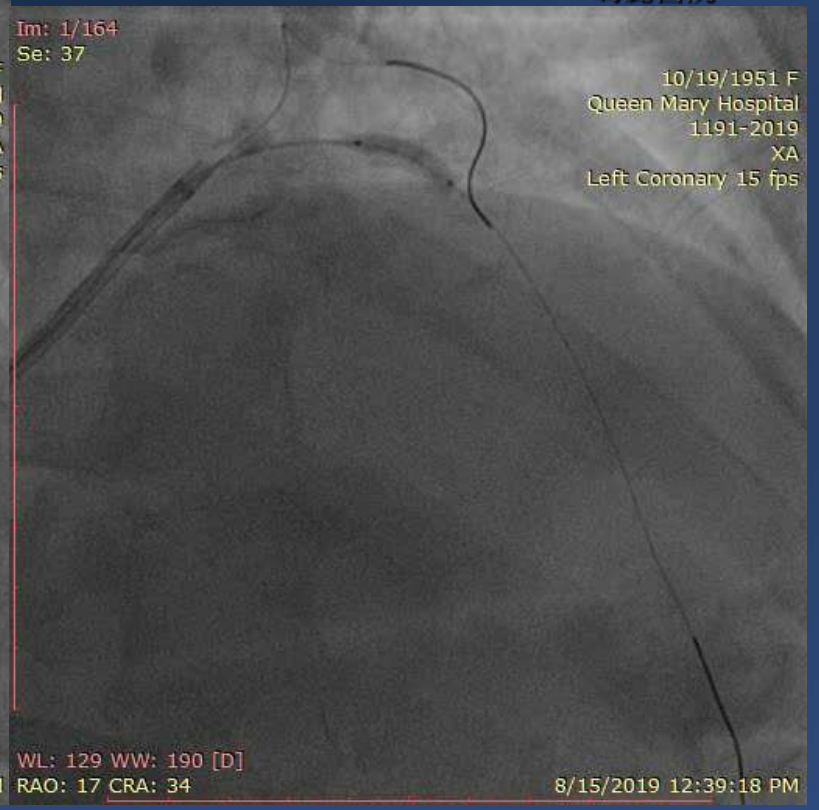
1 mm


A Area: 3.88mm²
Mean Diameter: 2.20mm
Min: 1.74mm Max: 2.63mm
29-AUG-2019 3:22:47 PM
0001
1 mm

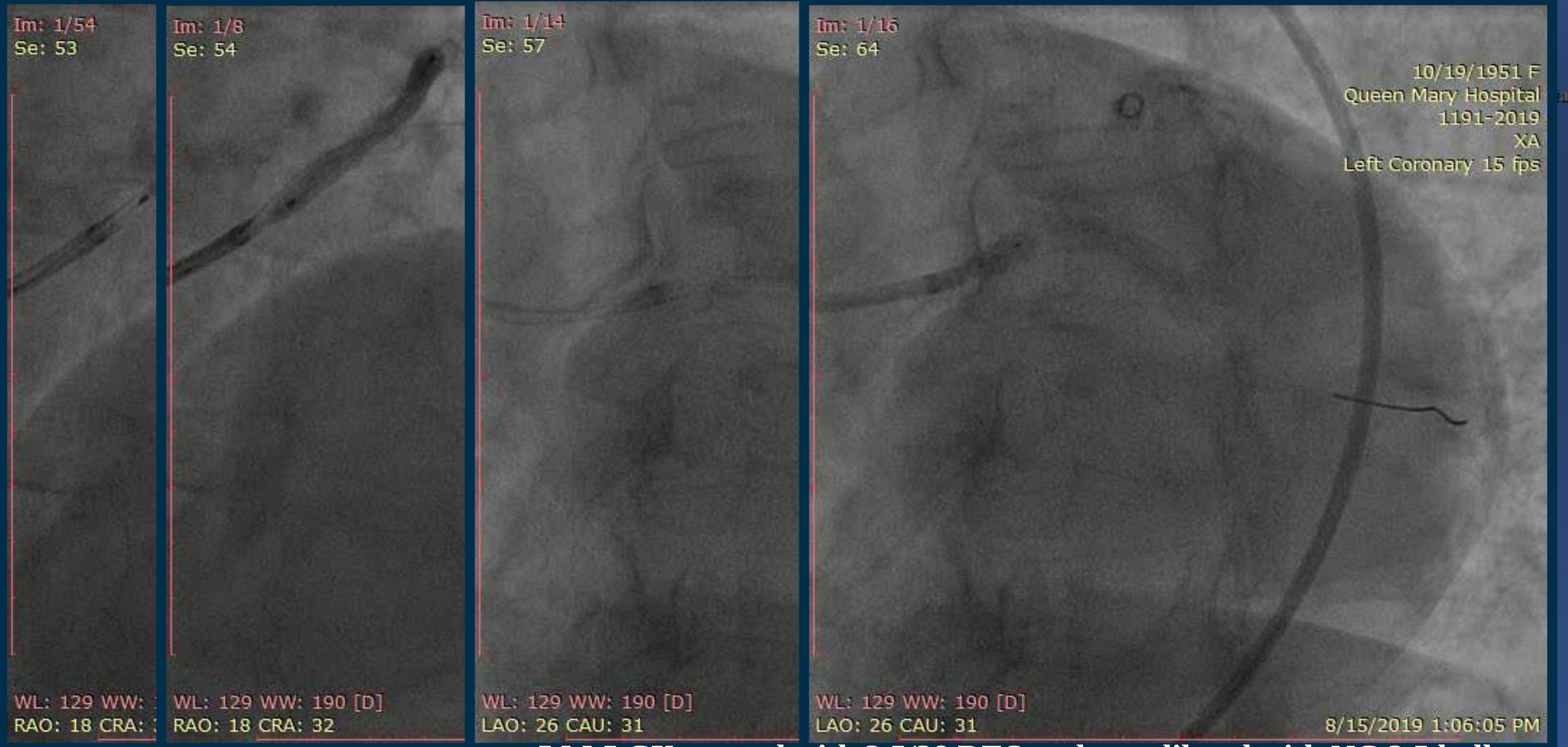


Shockwave balloon for plaque modification. 3.0 x 3 cycles, 10 seconds each. Ostial LCx lesion was dilated

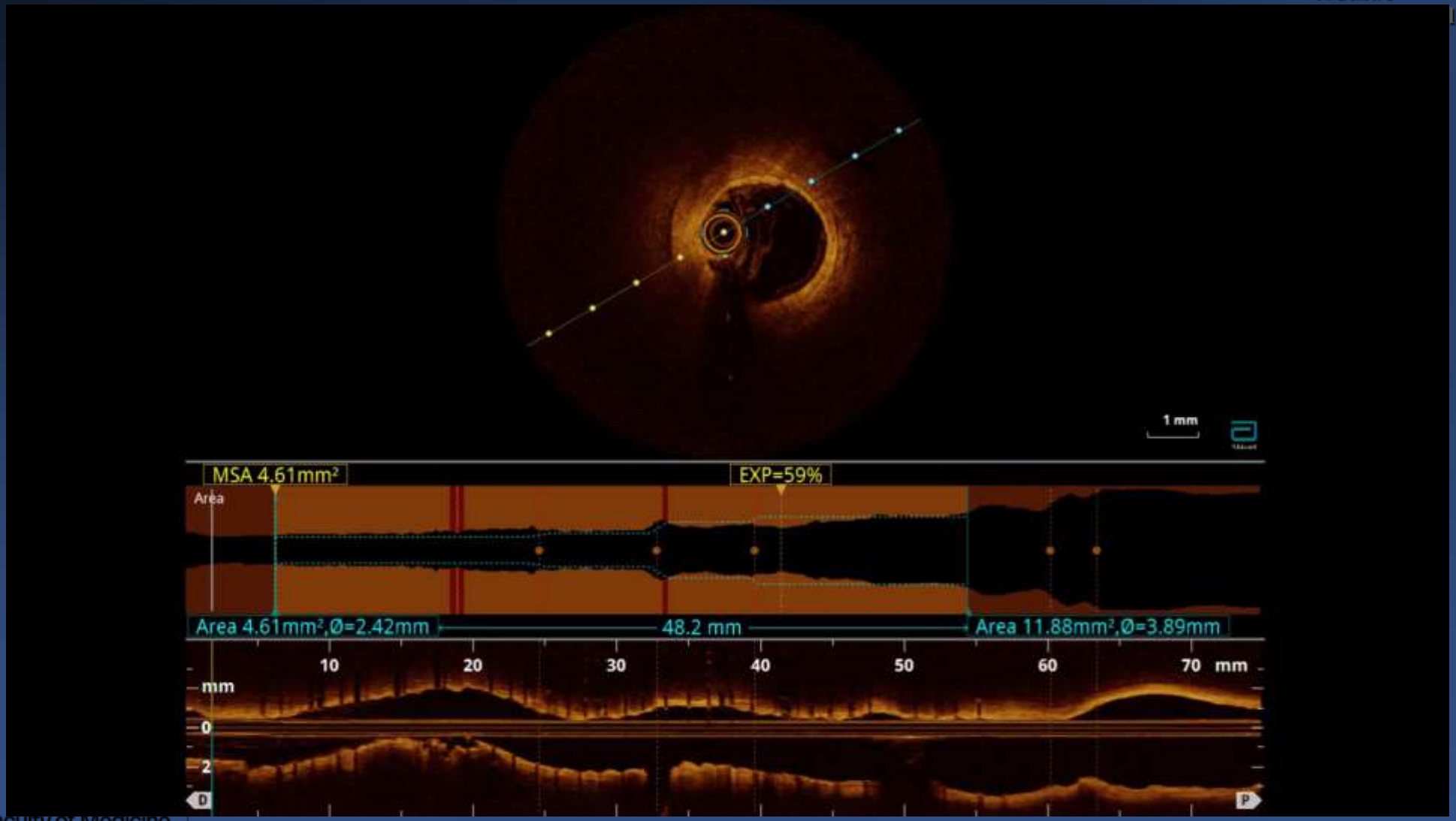


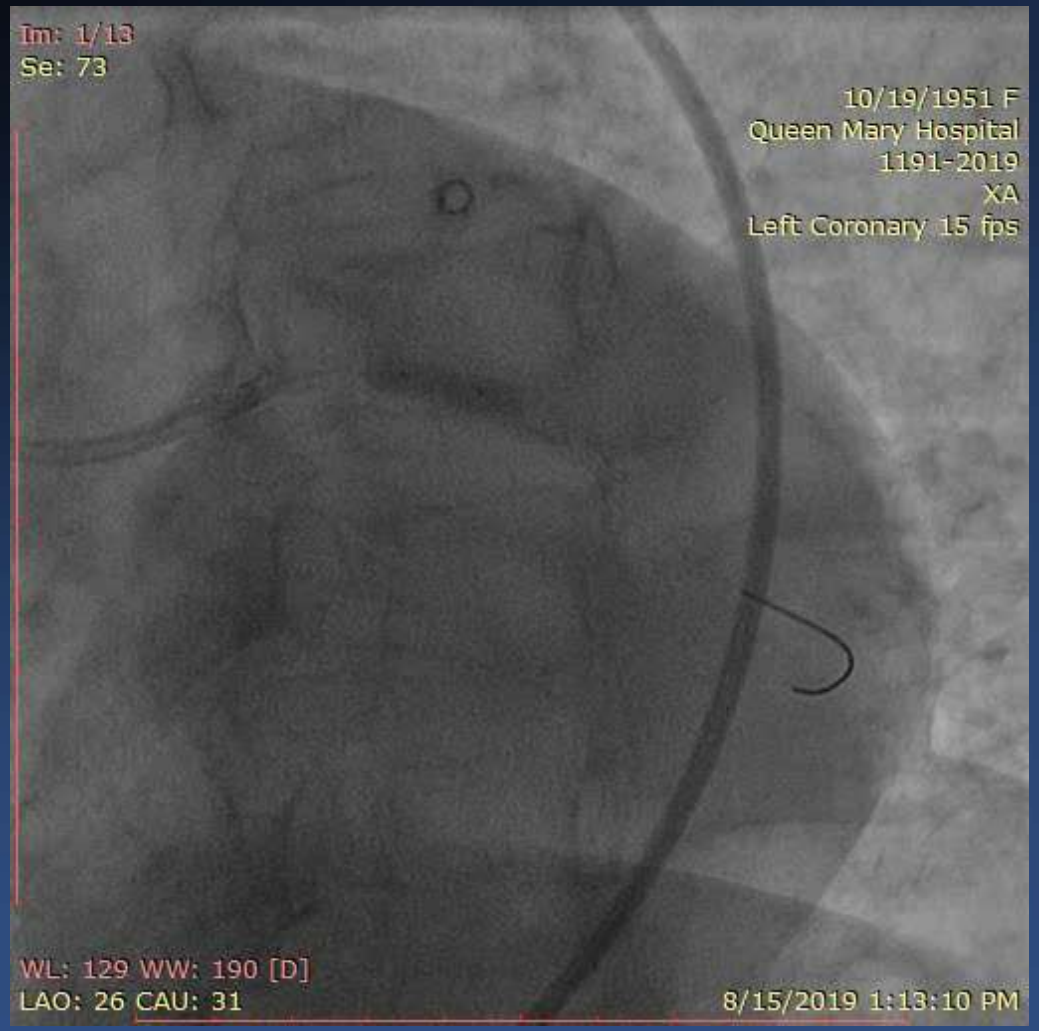


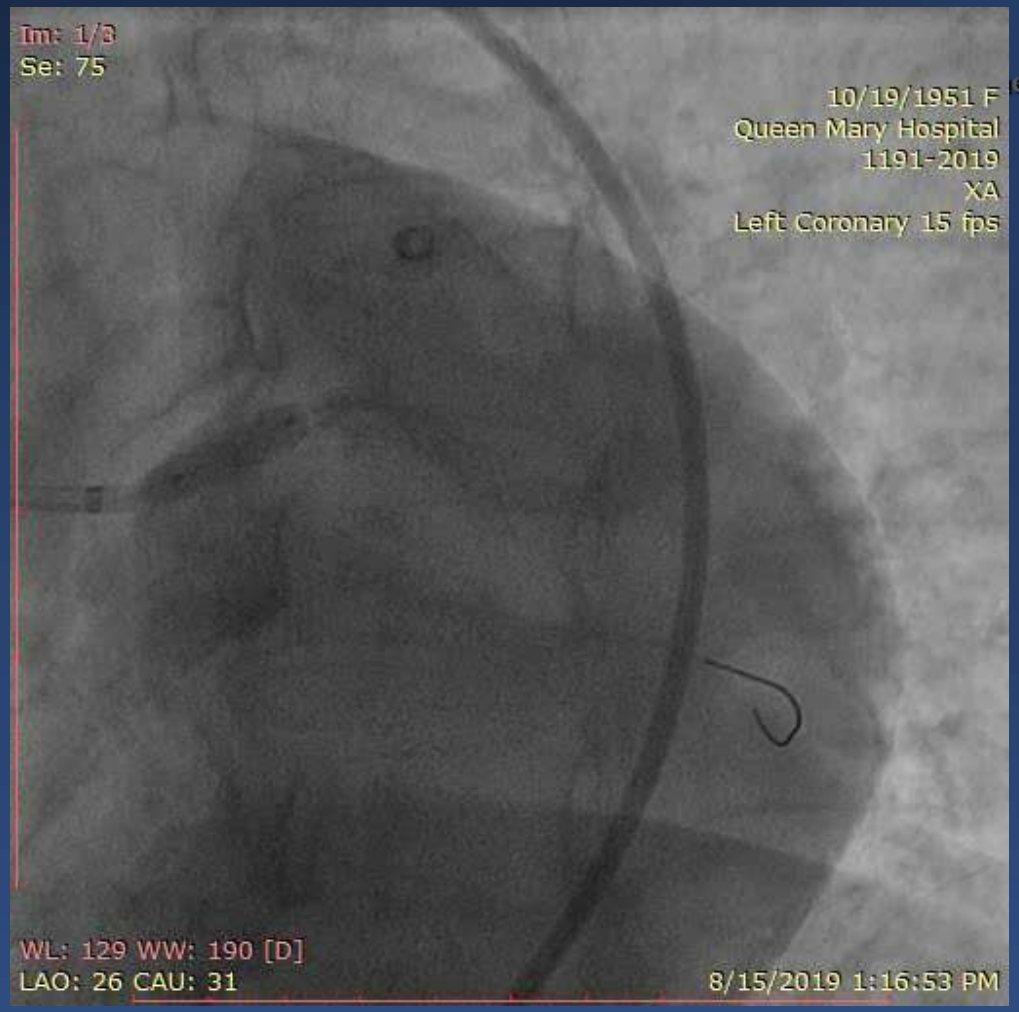
Sion blue to LAD, Shockwave balloon 3.0 for 3 cycles (10 seconds). lesion dilated.
LAD stented with 3.0/29 DES and postdilate with NC 3.0/20atm and NC 3.5 at 20atm. OCT showed good result.



LM-LCX stented with 3.5/38 DES and postdilated with NC 3.5 balloon at 20atm. POT with NC 4.5 balloon at 12 atm and 5.0 balloon at 6 atm.


1 mm
MSA 4.61mm²
EXP=59%
Area
Area 4.61mm²,Ø=2.42mm
48.2 mm
Area 11.88mm²,Ø=3.89mm
10
20
30
40
50
60
70 mm
mm
0
2
D
P





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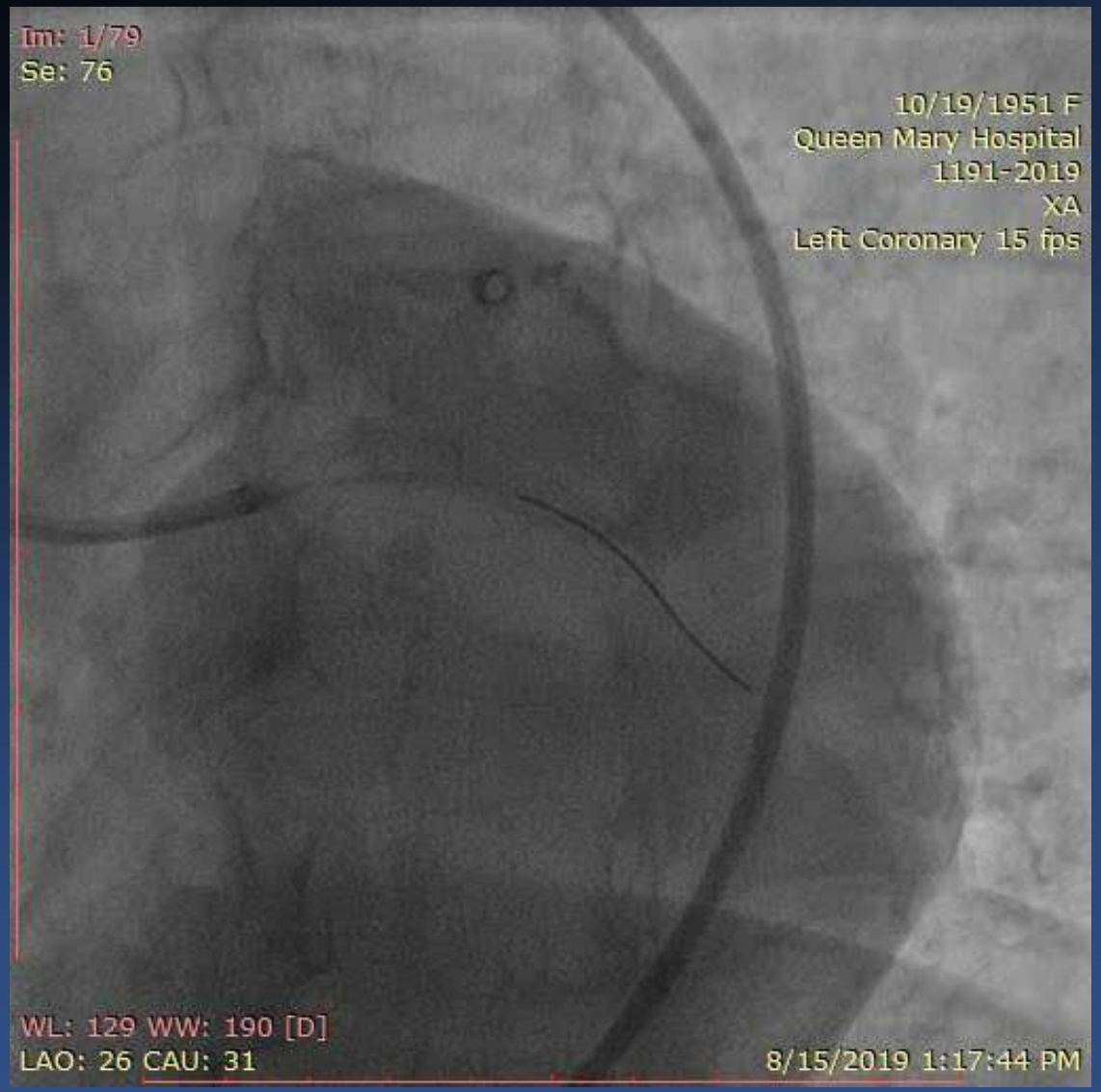
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Se: 76
10/19/1951 F
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XA
Left Coronary 15 fps
WL: 129 WW: 190 [D]
LAO: 26 CAU: 31
8/15/2019 1:17:44 PM


Im: 1/74
Se: 77
10/19/1951 F
Queen Mary Hospital
1191-2019
XA
Left Coronary 15 fps
WL: 129 WW: 190 [D]
RAO: 12 CRA: 35
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DISCUSSION

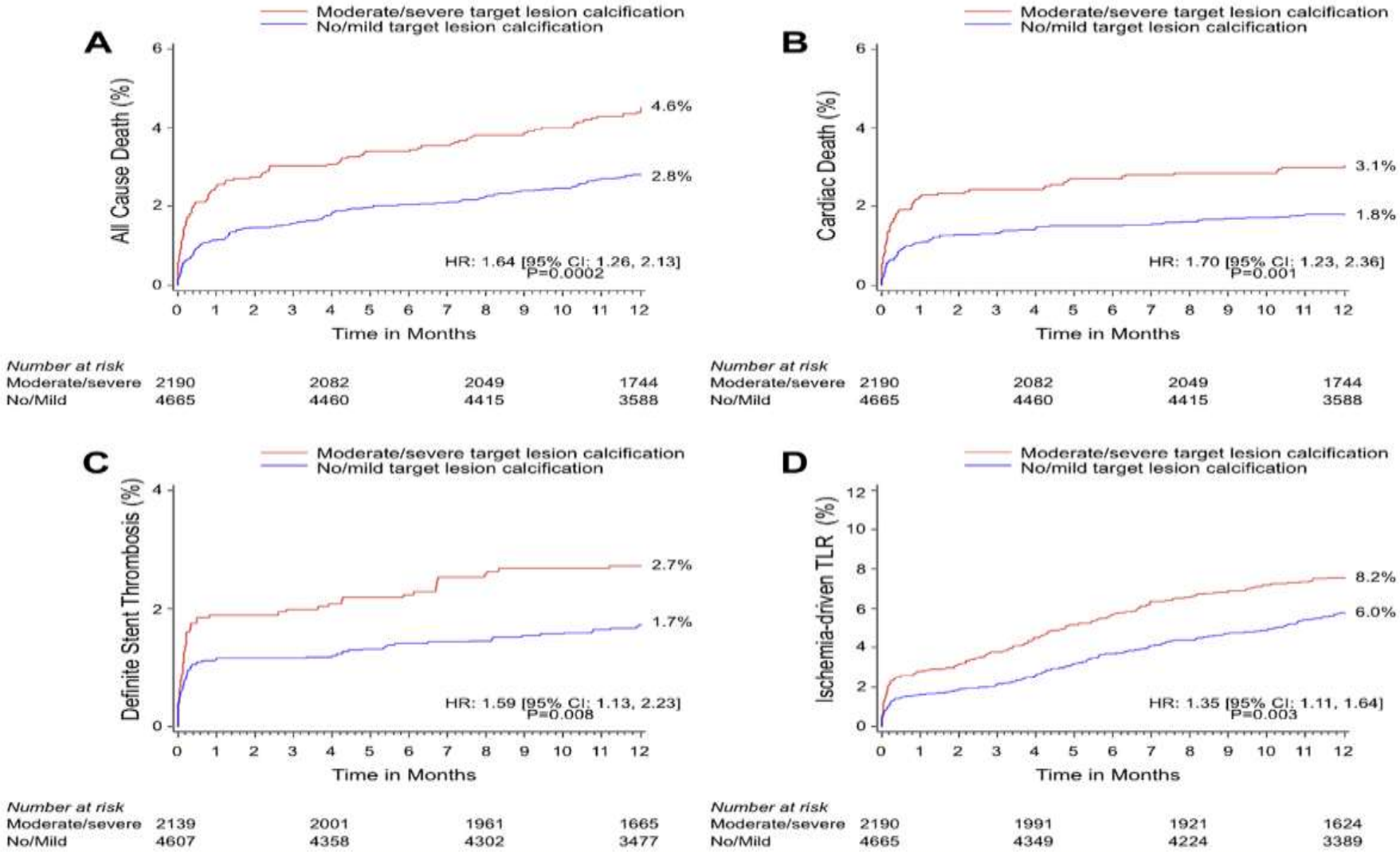


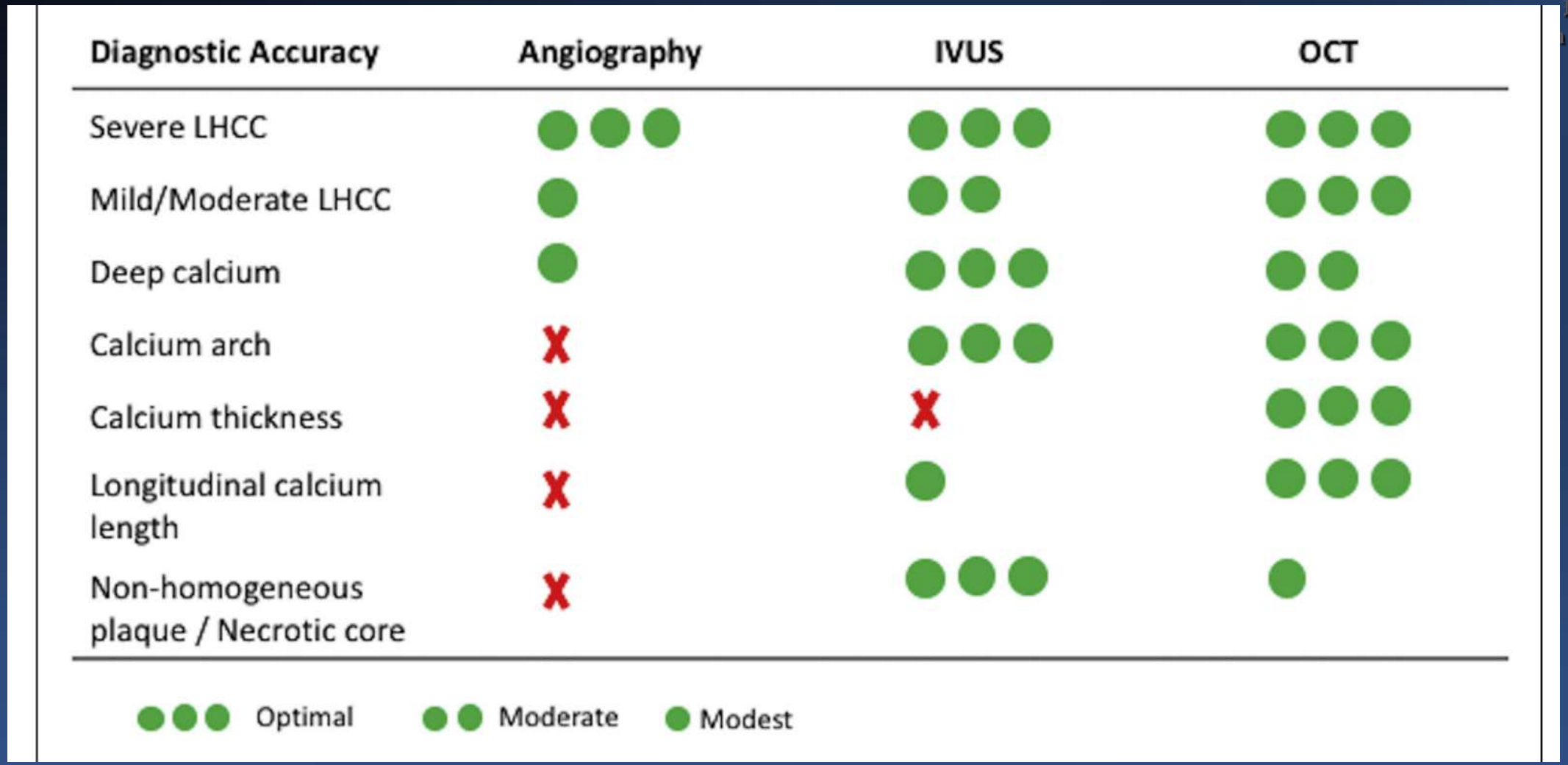
Figure 2 **Time-to-Event Curves Through 1 Year According to the Severity of Target Lesion Calcification**

Comparison of the cumulative event rates through 1 year in patients stratified by no to mildly (none/mild) compared with moderately to severely (moderate/severe) calcified target lesions. **(A)** All-cause death. **(B)** Cardiac death. **(C)** Definite stent thrombosis. **(D)** Ischemia-driven target lesion revascularization. HR = hazard ratio; other abbreviation as in Figure 1.

Généreux P, Madhavan MV, Mintz GS, Maehara A, Palmerini T, LaSalle L, et al. Ischemic Outcomes After Coronary Intervention of Calcified Vessels in Acute Coronary Syndromes: Pooled Analysis From the HORIZONS-AMI (Harmonizing Outcomes With Revascularization and Stents in Acute Myocardial Infarction) and ACUITY (Acute Catheterization and Urgent Intervention Triage Strategy) Trials. Journal of the American College of Cardiology. 2014;63(18):1845-54.

	Ablation Techniques			Balloon-Based Techniques			
	Rotational Atherectomy	Orbital Atherectomy	Excimer Laser	Cutting Balloon	Scoring Balloon	Super High-Pressure Balloon	Lithoplasty Balloon
Technical features							
Technology	High-speed rotating diamond-tipped burr	Rotating diamond-coated crown	Ultraviolet energy transmitted by multifiber laser catheters	Noncompliant balloon with longitudinally mounted microblades	Semicompliant balloon with scoring elements on the surface	Noncompliant twin-layer balloon	Semicompliant balloon with longitudinally mounted emitters delivering pulsatile mechanical energy
Mechanism of action	Differential cutting/ abrasion	Differential sanding/ abrasion	Photoablation/ vaporization	Plaque surface cutting	Plaque surface cutting	High inflation pressure (35–40 atm)	Lithotripsy
Device sizes	1.25–2.5 mm (burr)	1.25 mm (crown)	0.9–2 mm (catheter)	2.75–3.5 mm (balloon)	2.0–3.5 mm (balloon)	1.5–4.5 mm (balloon)	2.5–4 mm (balloon)
Minimal guide catheter size compatibility	6-F to 8-F	6-F	5-F to 8-F	6-F	6-F	6-F	6-F
Learning curve	Long	Long	Long	Short	Short	Short	Short
Clinical scenarios							
Main clinical indication	Calcific lesion preparation	Calcific lesion preparation	Uncrossable lesions/in-stent restenosis	In-stent restenosis	In-stent restenosis	Stent optimization	Calcific lesion preparation
Optimal calcium configuration	Luminal	Luminal	Luminal/abluminal	Luminal	Luminal	Luminal	Luminal/abluminal
In-stent restenosis	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cons							
Limited crossability	No	No	No	Yes	No	Yes	Yes
Risk of perforation	Moderate	Moderate	Moderate	Low	Low	Low	Low
Major dissection	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Low
Risk of burr lodging	Moderate	Unlikely	—	—	—	—	—
Slow/no reflow	Moderate	Moderate	Low	Low	Low	Low	Low
Best practice							
Atherectional speed	135.000–180.000	80.000–120.000	—	—	—	—	—
Device to vessel ratio	≤0.6	—	≤0.6	1:1	1:1	1:1	1:1
Recommended practice	Pecking motion/ short duration of ablation/ short ablated segment	Continuous slow forward and backward movement	Laser activation under constant flushing	Slow and gradual inflation	Slow and gradual inflation	Slow and gradual inflation	Prolonged balloon inflation at 6 atm allowing delivery of 10 impulses per inflation

De Maria GL, Scarsini R, Banning AP. Management of Calcific Coronary Artery Lesions. Is it Time to Change Our Interventional Therapeutic Approach? 2019;12(15):1465-78.



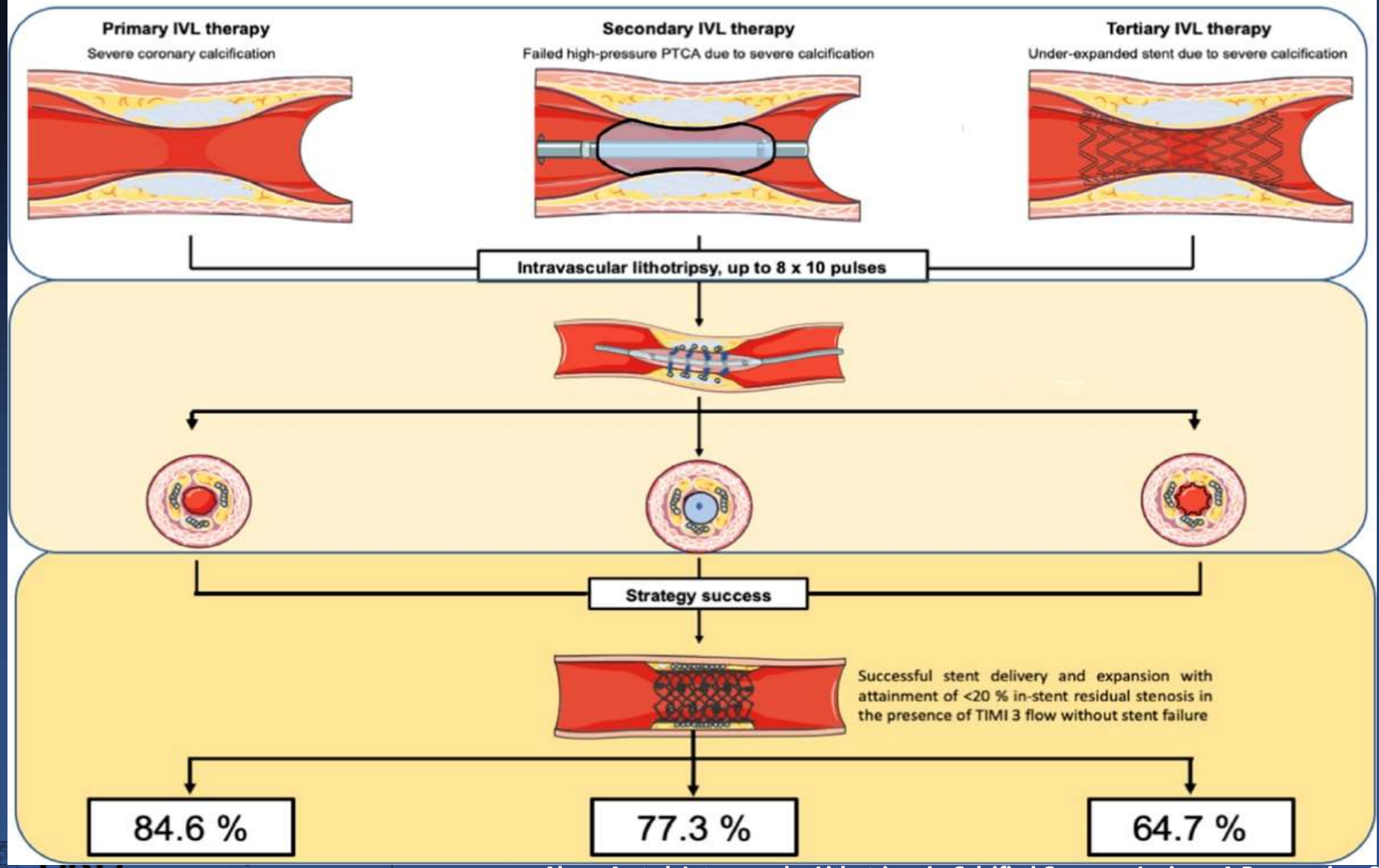
De Maria GL, Scarsini R, Banning AP. Management of Calcific Coronary Artery Lesions. Is it Time to Change Our Interventional Therapeutic Approach? 2019;12(15):1465-78.

Discussion Points

Diameter (mm)	Length (mm)	Max Pulse Count	Guidewire Compatibility (in)	Guide Catheter Compatibility	Working Length (cm)	Tip Profile (in)*	Crossing Profile (in)*
2.5	12	80	0.014	6F	138	0.023	0.042
3.0	12	80	0.014	6F	138	0.023	0.042
3.5	12	80	0.014	6F	138	0.023	0.042
4.0	12	80	0.014	6F	138	0.023	0.042

Ali Z et al. J Am Coll Cardiol Imaging 2017: 10(8): 897-906

Strategy success and safety of intravascular coronary lithotripsy in calcified lesions of an all-comers cohort of patiens

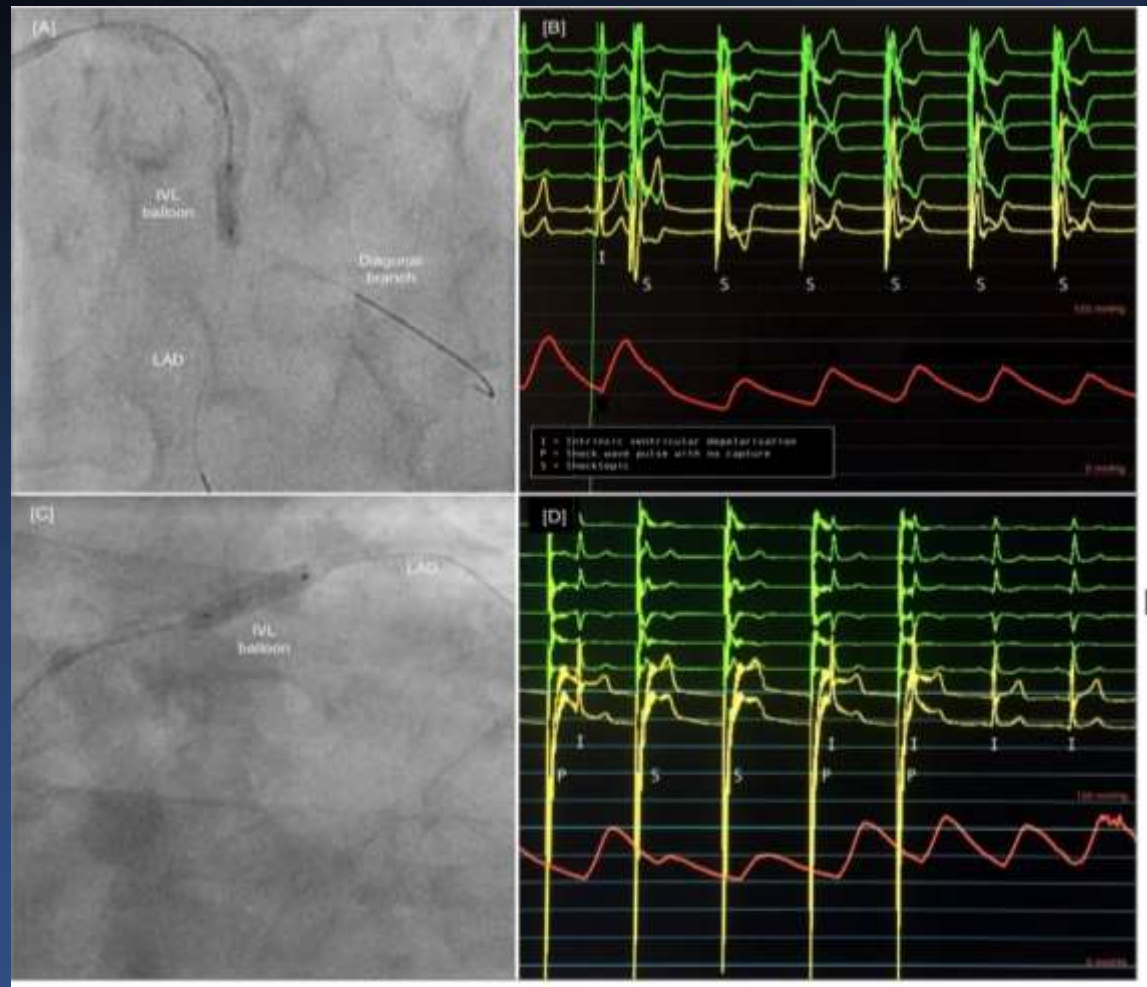


Aksoy A et al. Intravascular Lithotripsy in Calcified Coronary Lesions: A Prospective, Observational, Multicenter Registry. Circulation Cardiovascular interventions. 2019;12(11):e008154.

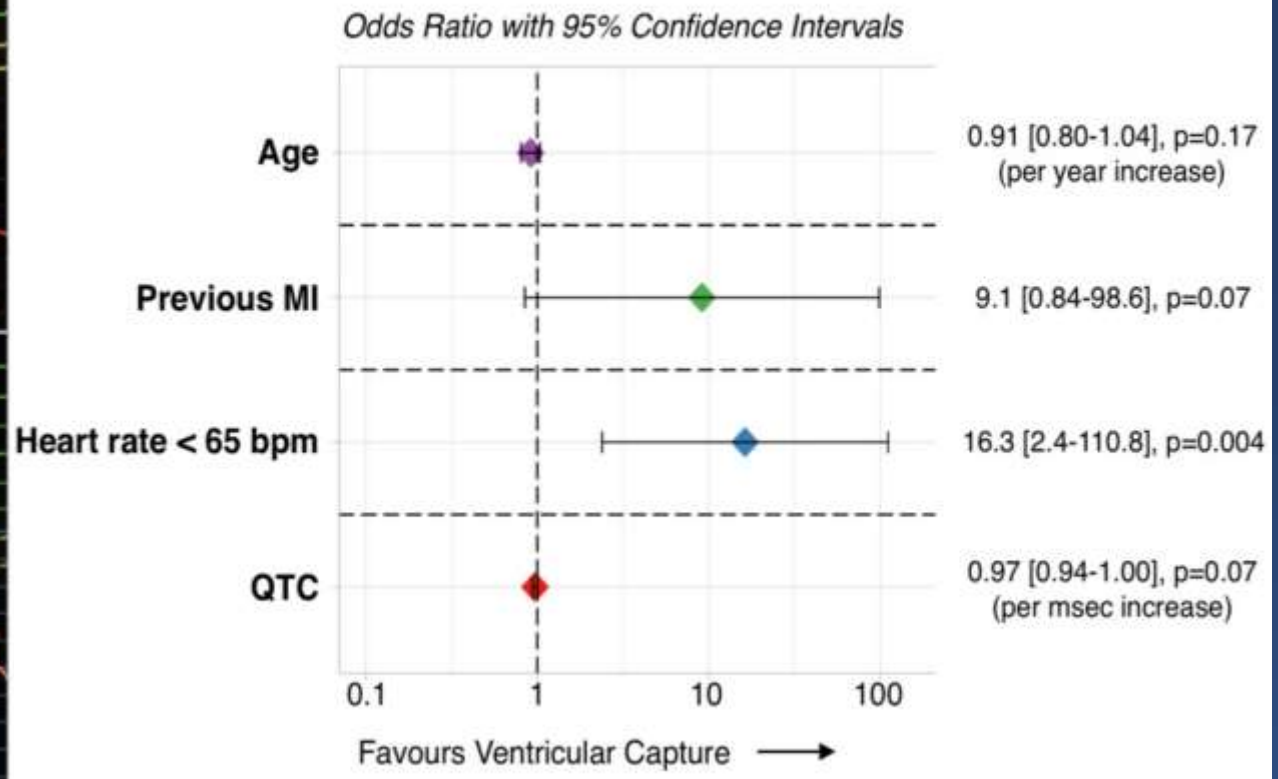
	Disrupt CAD I[34]	Disrupt PAD I/II[49,50]	Disrupt BTK[51]
	Multicentre – Single-arm		
No. of patients, no. of sites	60 patients, 7 sites	PAD I: 35 patients, 3 sites PAD II: 60 patients, 8 sites	20 patients, 3 sites
Inclusion criteria	– *de novo* moderate/severe calcific coronary lesions – stenosis ≥50% – RVD 2.5-4.0 mm – lesion length <32 mm	– intermittent claudication (Rutherford Class 2–4) – ABI ≤0.9 – moderate/severe calcification – SFA/popliteal lesions >70% stenosis – RVD 3.5-7.0 mm – lesion length ≤150 mm	– intermittent claudication (Rutherford Class 3–5) – moderate/severe infrapopliteal disease – infrapopliteal lesions ≥50% stenosis – RVD 2.5–3.5 mm – lesion length ≤150 mm
Procedural success	98.3%	100%	95%
Clinical success	95%	98.9%	95%
Acute gain	1.7 mm	2.9 mm	1.5 mm
30-day MACE/MAE	5.0%	1.1%	0.0%
6-month MACE/MAE	8.3%	1.1%	–

ABI: ankle-brachial index; MACE: major adverse cardiovascular events; MAE: major adverse events; MI: myocardial infarction; RVD: reference vessel diameter; SFA: superficial femoral artery

Carlotta Sorini Dini et al. Intravascular lithotripsy for calcific coronary and peripheral artery stenoses. EuroIntervention. 2019;15(8):714-21.



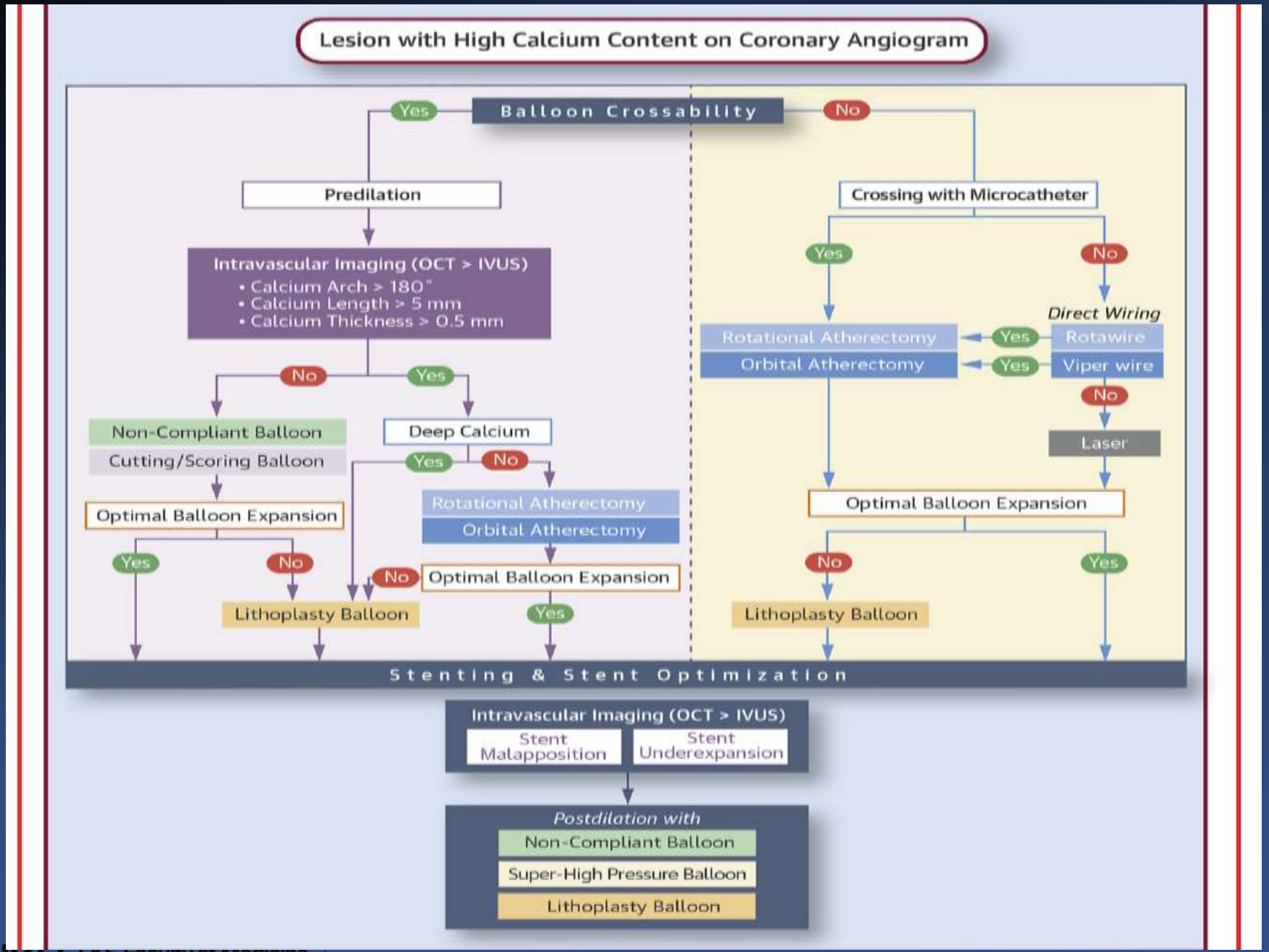
Predictors of Ventricular Capture with Coronary IVL



Wilson SJ et al. Coronary intravascular lithotripsy is associated with a high incidence of "shocktopics" and asynchronous cardiac pacing. EuroIntervention. 2019.

	Rotablator	Orbital atherectomy	IVL
Guidewire	0.09" proprietary wire	0.014" proprietary wire	0.014" wire of choice
Lesion crossing	+++ 1st line for balloon uncrossable lesions		– Higher crossing profile than contemporary balloons
Wire bias	+++ Calcium modification wire-bias dependent		– Balloon inflation eliminates wire bias, providing circumferential calcium modification
Side branch protection	– Side branch wire must be removed during atherectomy		+++ No interaction with side branch wire
Distal embolisation	++ Atherectomy actively liberates atherosclerotic debris		– Theoretically same risk as contemporary angioplasty balloon
Perforation	++ Accepted risk of atherectomy, higher in tortuous anatomy		– No recorded perforations
Bradyarrhythmias	+++ Temporary pacemaker standard of care in dominant coronary atherectomy	++ Temporary pacemaker may be considered in dominant coronary atherectomy	– No recorded arrhythmia
Plaque ablation	++ Dependent on selected burr size	+++ Increased atherectomy with increased minimal lumen area	– No plaque ablation
Effect of deep calcium	– Atherectomy impacts on superficial calcium only		+ Theoretically modifies deep calcium

Carlotta Sorini Dini et al. Intravascular lithotripsy for calcific coronary and peripheral artery stenoses. EuroIntervention. 2019;15(8):714-21.



De Maria GL, Scarsini R, Banning AP. Management of Calcific Coronary Artery Lesions. Is it Time to Change Our Interventional Therapeutic Approach? 2019;12(15):1465-78.

Conclusion/Take-home Message

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- High calcium content obstructive lesions challenging
- Proper selection of balloon-based and ablative strategy important and imaging important
- OCT ideal to assess calcium
- Rotational atherectomy best initial option in uncrossable lesion
- Combination rotational atherectomy followed by intravascular lithotripsy may improve lesion preparation in uncrossable lesion
- intravascular lithotripsy still feasible and safe in the presence of large hematoma