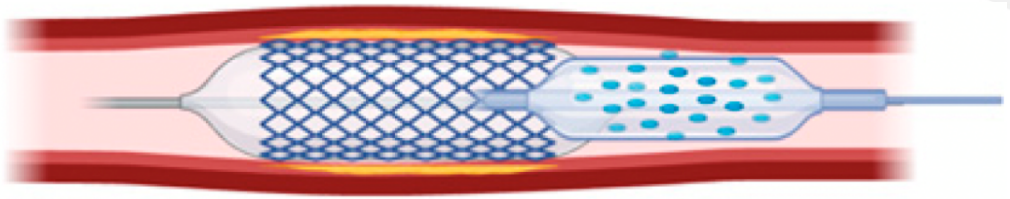


The Role of DCB in Combination with DES:

hybrid approach

Mariano Pellicano MD, PhD, MSc

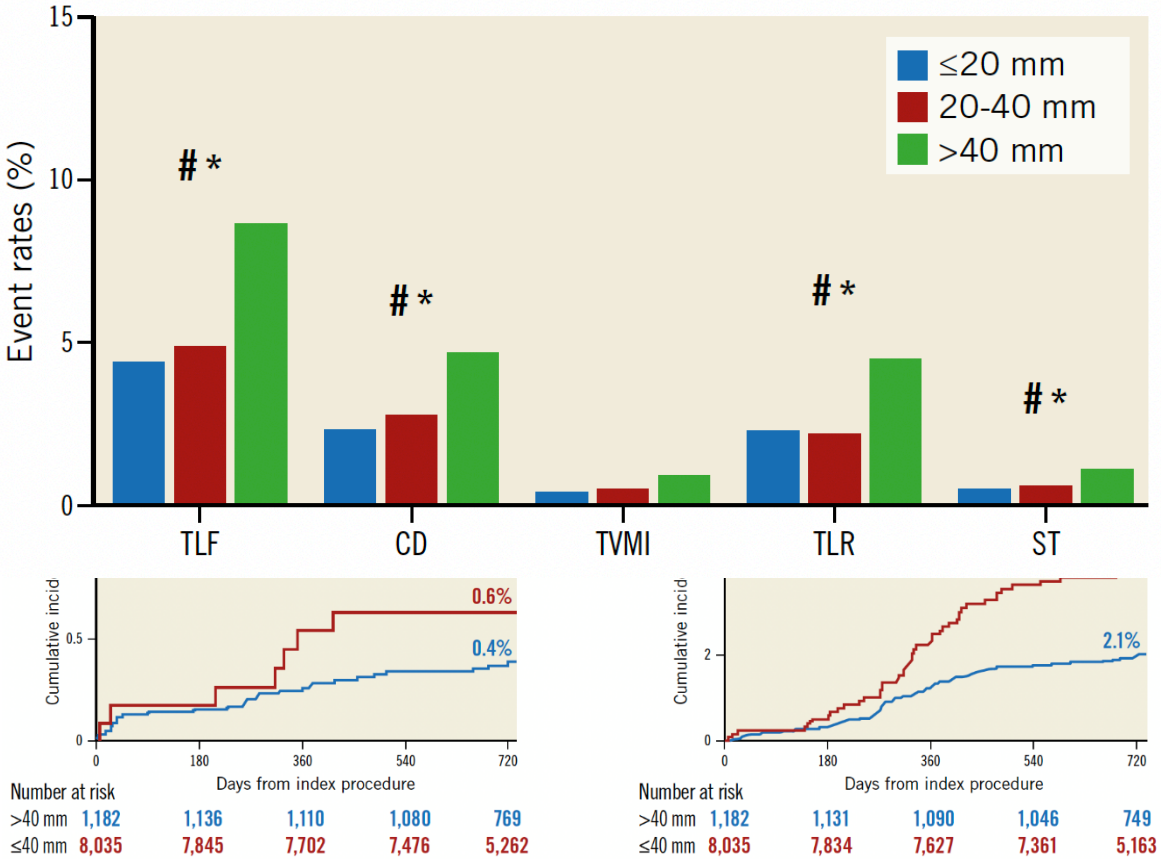
Galeazzi – Sant'Ambrogio Hospital, Milan, Italy

Stent Length and Hard Events

Single lesion PCI

GRAND-DES registry

patient-level pooled analysis (9217 pts)
8035 pts short stenting group (≤ 40 mm)
1182 pts long stenting group (> 40 mm)



2-Year Follow-up ILUMIEN IV

Prospective, single-blind trial of 2487 high-risk patients randomized to OCT-guided vs. angio-guided DES (Xience) implantation

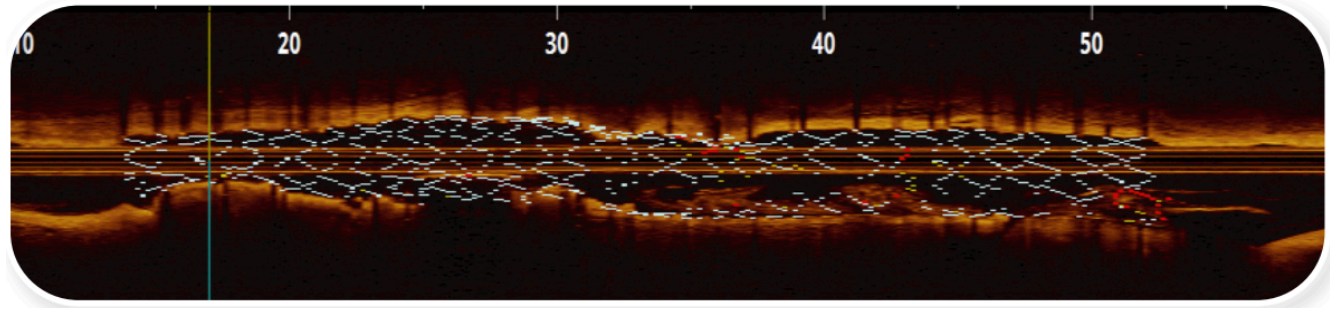


Table 6 **Optical coherence tomography findings independently associated with clinical endpoints (adjusted analysis)**

Outcome	*N*	OCT variable	Hazard ratio (95% CI)	*P*-value
Target lesion failure	1997	Minimal stent area, per 1 mm^2	0.76 (0.68–0.86)	<.0001
		Proximal edge dissection, any	1.77 (1.20–2.62)	.004
Cardiac death or TV-MI	2128	Minimal stent area, per 1 mm^2	0.82 (0.70–0.95)	.009
		Stent length, per 5 mm	1.08 (1.02–1.15)	.009
Ischaemia-driven TLR	1997	Intra-stent flow area, per 1 mm^2	0.72 (0.62–0.84)	<.0001
		Proximal edge dissection, any	1.88 (1.16–3.03)	.01
		Plaque or thrombus protrusion, major	1.95 (0.97–3.92)	.06
Stent thrombosis	2128	Minimal stent expansion, per 10%	0.71 (0.55–0.93)	.01

N, the number of patients included in each analysis model.
CI, confidence interval; OCT, optical coherence tomography; ref, reference; TLR, target lesion revascularization; TV-MI, target vessel myocardial infarction.

Kong MG et al. EuroIntervention. 2021 Mar 19;16(16):1318-1325.
Landmesser U et al. Eur Heart J. 2024 Nov 14;45(43):4630-4643.

Full Metal Jacket PCI

Circulation: Cardiovascular Interventions
Volume 2, Issue 5, October 2009; Pages 416-422
https://doi.org/10.1161/CIRCINTERVENTIONS.109.886945

ORIGINAL ARTICLE

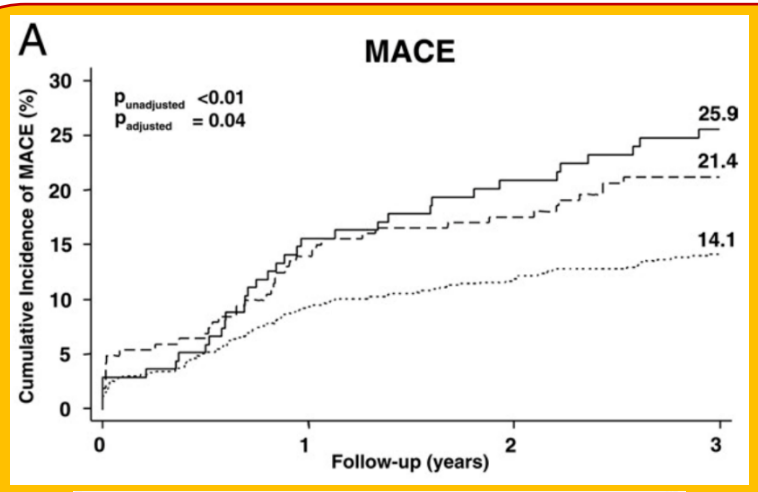
Long-Term Follow-Up on a Large Cohort of "Full-Metal Jacket" Percutaneous Coronary Intervention Procedures

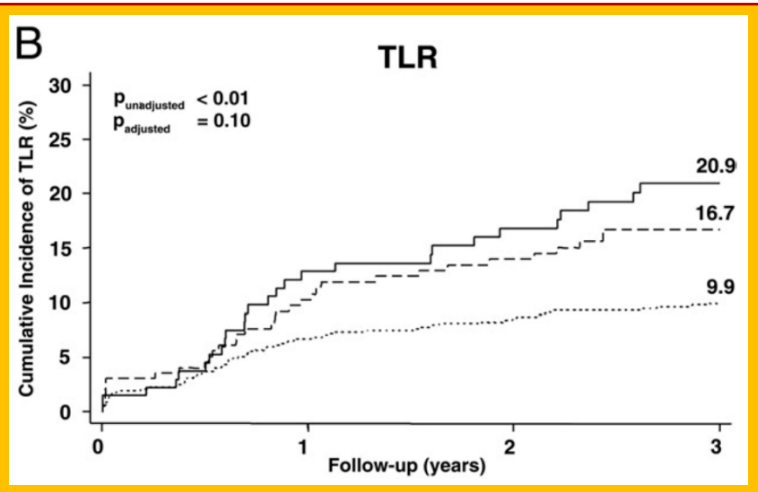
Andrew S.P. Sharp, MBChB, Azeem Latib, MBBCh, Alfonso Ielasi, MD, Claudio Larosa, MD, Cosmo Godino, MD, Marta Saolini, MD, Valeria Magni, MD, Robert T. Gerber, PhD, Matteo Montorfano, MD, Mauro Carlino, MD, Iassen Michev, MD, Alaide Chieffo, MD, and Antonio Colombo, MD

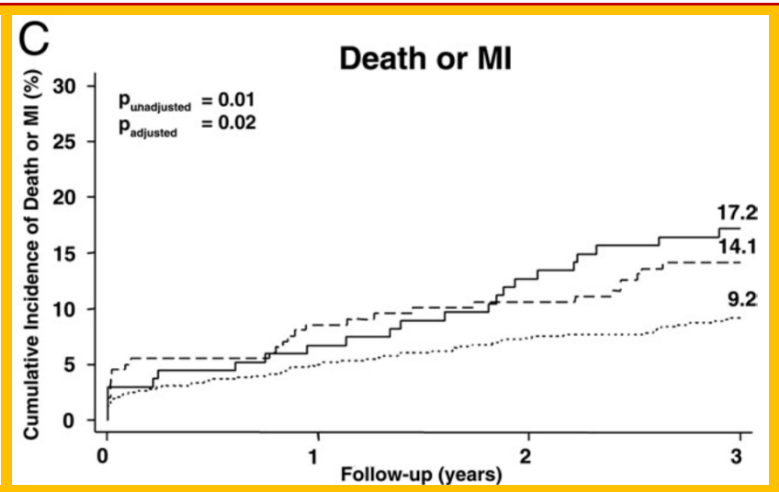
- n=658 lesions in 617 patients (2002-2007)
- **Full metal jacket definition:** ≥60 mm overlapping DES in long lesions
- **Procedure-related MI** (single-vessel FMJ): **9.5%**
- **Procedure related MI** as part of a multivessel procedure: **19.0%**
- **Median duration of clinical follow-up**: 39 months (interquartile range, 28 to 50)
- **TLR: 23.4%**
- **ARC definite/probable stent thrombosis:** 2.6%

Sharp A et al, Circ CV Intv 2009

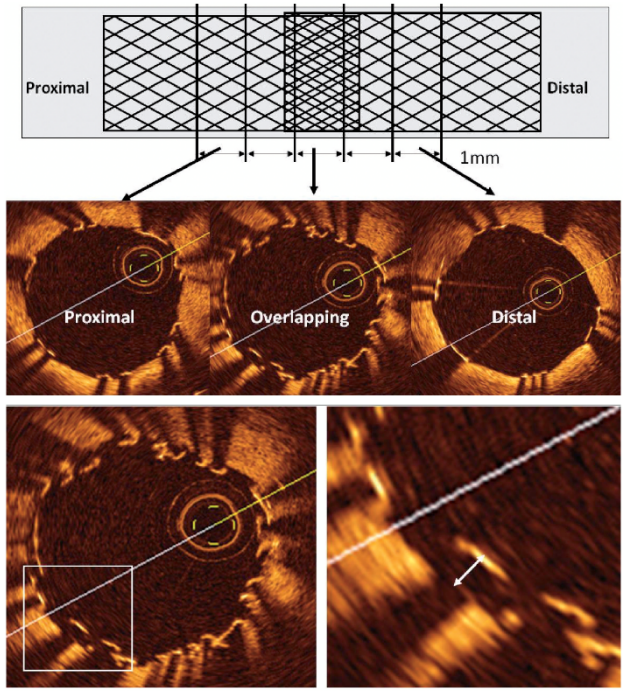
"Achilles' heel" of overlapping stents

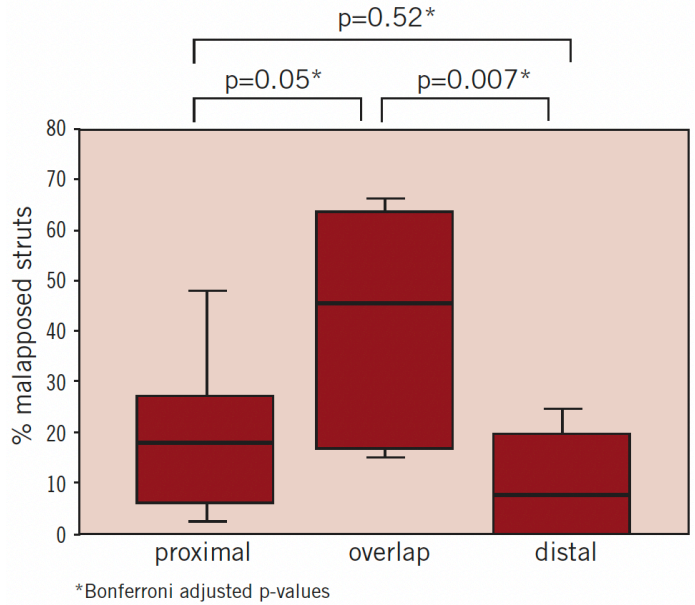




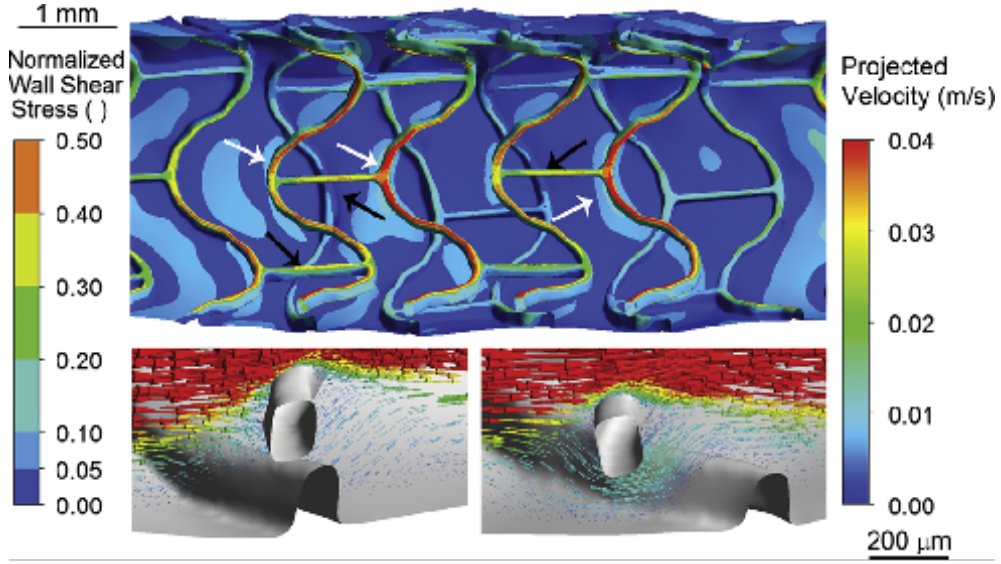


Multiple DES, overlap ····· Single DES
Multiple DES, no overlap





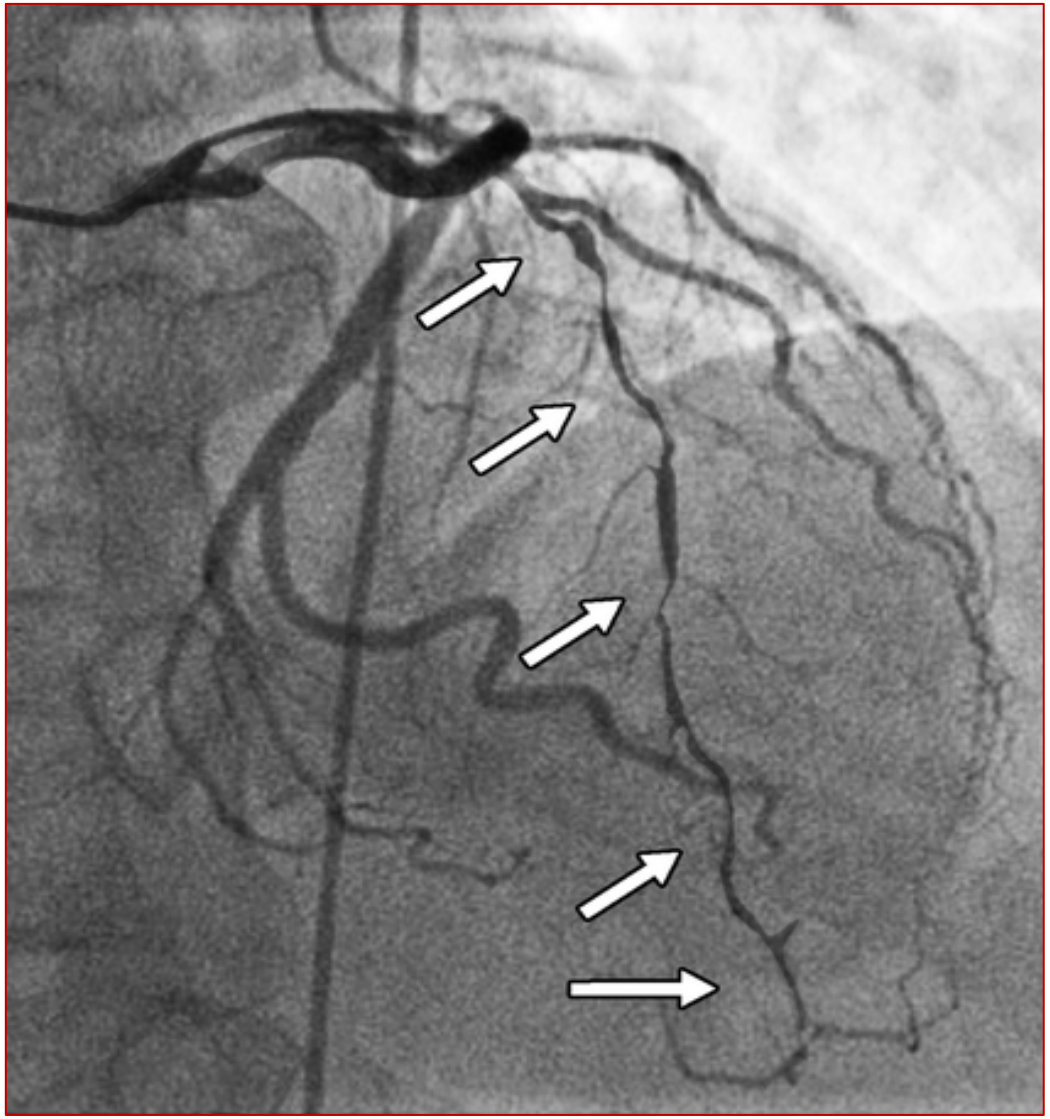
*Bonferroni adjusted p-values

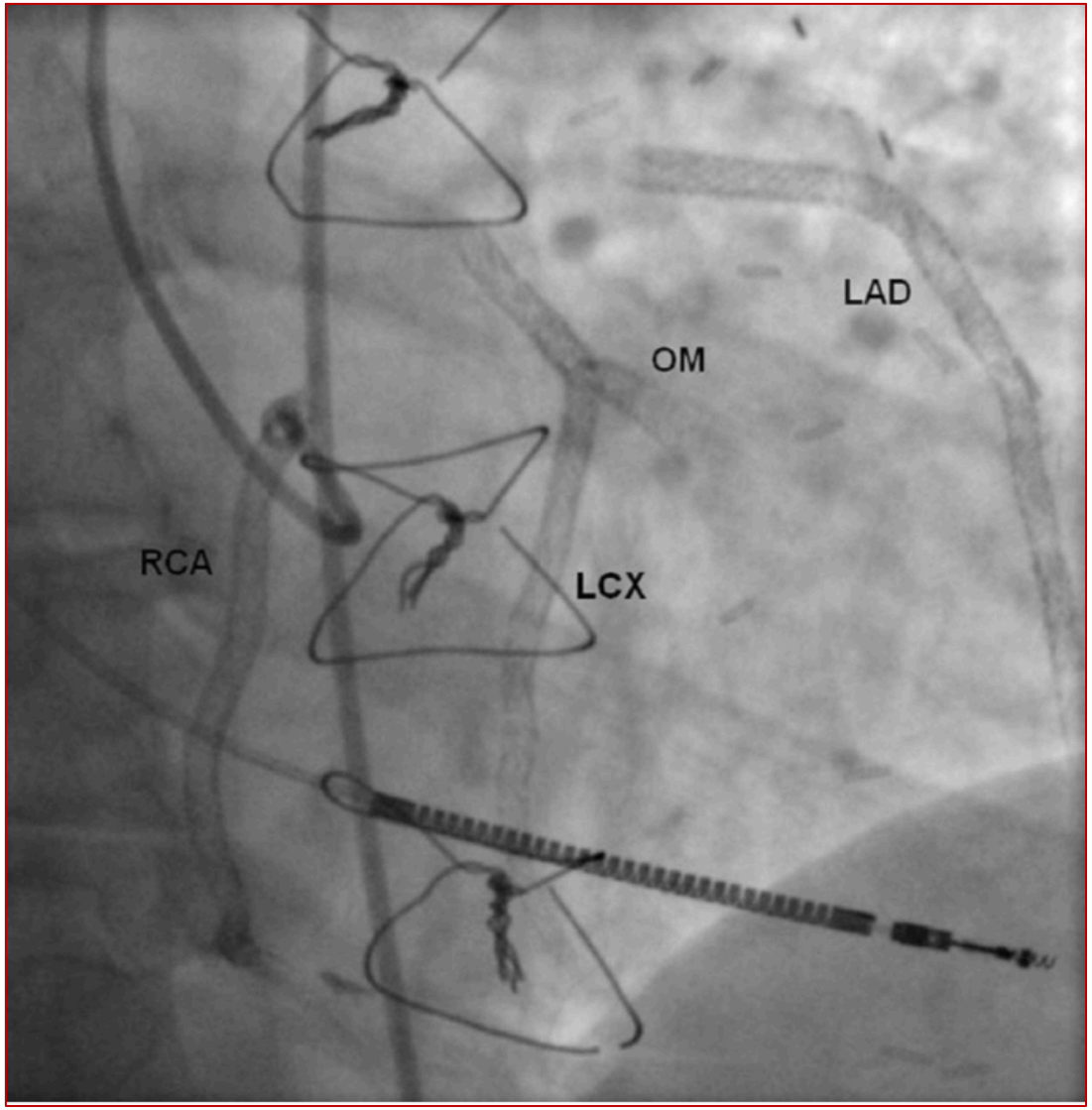


- **40% rate of struts malapposition within an overlapped DES segment**
- **delay in endothelialisation in overlapping area**

Tanigawa J et al. EuroIntervention. 2008 Mar;3(5):580-3.
Räber L et al. J Am Coll Cardiol. 2010 Mar 23;55(12):1178-1188.
CJ O'Sullivan et al. EuroIntervention. 2014 Jan 22;9(9):1076-84.

How To Manage Diffuse CAD?





DCB Technologies

Device	Company	Vessel Territory	Polymer Coating	Drug Dose, μg/mm²
Paclitaxel				
Agent	Boston Scientific	Coronary	Acetyltributylcitrate	2
Danubio	Minvasys	Coronary	N-butyryl tri-n-hexyl citrate	2.5
Restore	Cardionovum	Coronary	Shellac	3
AngioSculptX	Philips	Coronary	Nordihydroguaiaretic acid	3
Essential	iVascular	Coronary	Organic ester	3
ElutaX	Aachen Resonance	Coronary/peripheral	Polymer free	2.2
Ranger	Boston Scientific	Peripheral	Acetyltributylcitrate	2
Lutonix	BD Interventional	Coronary/peripheral	Polysorbate and sorbitol	2
IN.PACT/Prevail	Medtronic	Coronary/peripheral	Urea	3.5
StellareX	Philips	Peripheral	PEG	2
Dior I/II/Biostream	Eurocor Biosensors	Coronary/peripheral	Shellac	3
Protégé	Blue Medical	Coronary	Hydrophilic coating	3
Pantera Lux	Biotronik	Coronary/peripheral	N-butyryl tri-n-hexyl citrate	3
SeQuent Please NEO	B. Braun	Coronary	Iopromide	3
SeQuent Please OTW	B. Braun	Peripheral	Resveratrol	3
GENOSS	Genoss	Coronary	Shellac + vitamin E	3
Sirolimus				
Selution	MedAlliance	Coronary/peripheral	Cell-adherence technology	*
Virtue	Caliber Therapeutics	Coronary/peripheral	Biodegradable polyester	*
MagicTouch	Concept Medical	Coronary/peripheral	Phospholipid	*
SeQuent SCB	B. Braun	Coronary/peripheral	BHT	4
Biolimus				
BA9	Biosensors Europe	Coronary	Polyethylene oxide	3
Sirolimus and paclitaxel				
SirPlux Duo	Advanced NanoTherapies	Coronary/peripheral	Biodegradable nanoparticle	1.35 (sirolimus)/0.15 (paclitaxel)

OPTIMAL LESION PREPARATION BEFORE DCB

- Standard balloon (SC, NC) 1:1 sized on distal RVD [9] — Exp
- **Long inflations** (>30 sec) are recommended [134,135] — Exp
- **Specialty balloons** (scoring, cutting) are recommended to improve lesion preparation and decrease the risk of flow-limiting dissections [133,136] — RCT
- **Intravascular imaging** is encouraged for more precise assessment of vessel size and calibrated DCB selection, plaque composition and morphology [25,85]
  - IVI may lead to superior angiographic outcomes after DCB-only PCI [85] — RCT
- **Calcium debulking** (IVL, RA, OA) is recommended in case of moderate-to-severe calcification [98,99] — Exp

ACCEPTABLE RESULT FOLLOWING LESION PREPARATION

ANGIOGRAPHY

RESIDUAL STENOSIS

- **Visual estimation** [9]: ≤30% — Exp
- **QCA** [*,12,13] — Exp
  - *Optimal*: ≤25%
  - *Suboptimal*: 25-40%

INTRAVASCULAR IMAGING

- Media dissections may facilitate drug transfer to the vessel wall [75] — Exp
- No evidence-based IVI criteria is currently established for DCB optimization

NON FLOW-LIMITING DISSECTIONS — Exp

- TIMI 3 flow
- No ECG changes
- No chest pain

CORONARY PHYSIOLOGY (FFR/QFR/NHPR)

- No evidence-based threshold is currently available
- Pd/Pa >0.90 [137]
- QFR/FFR >0.80 [9] — Exp

YES

DCB

- **SHORT DELIVERY TIME** <2 minutes [9]
- **LONG INFLATION TIME** ≥60 seconds [134,135] — Exp

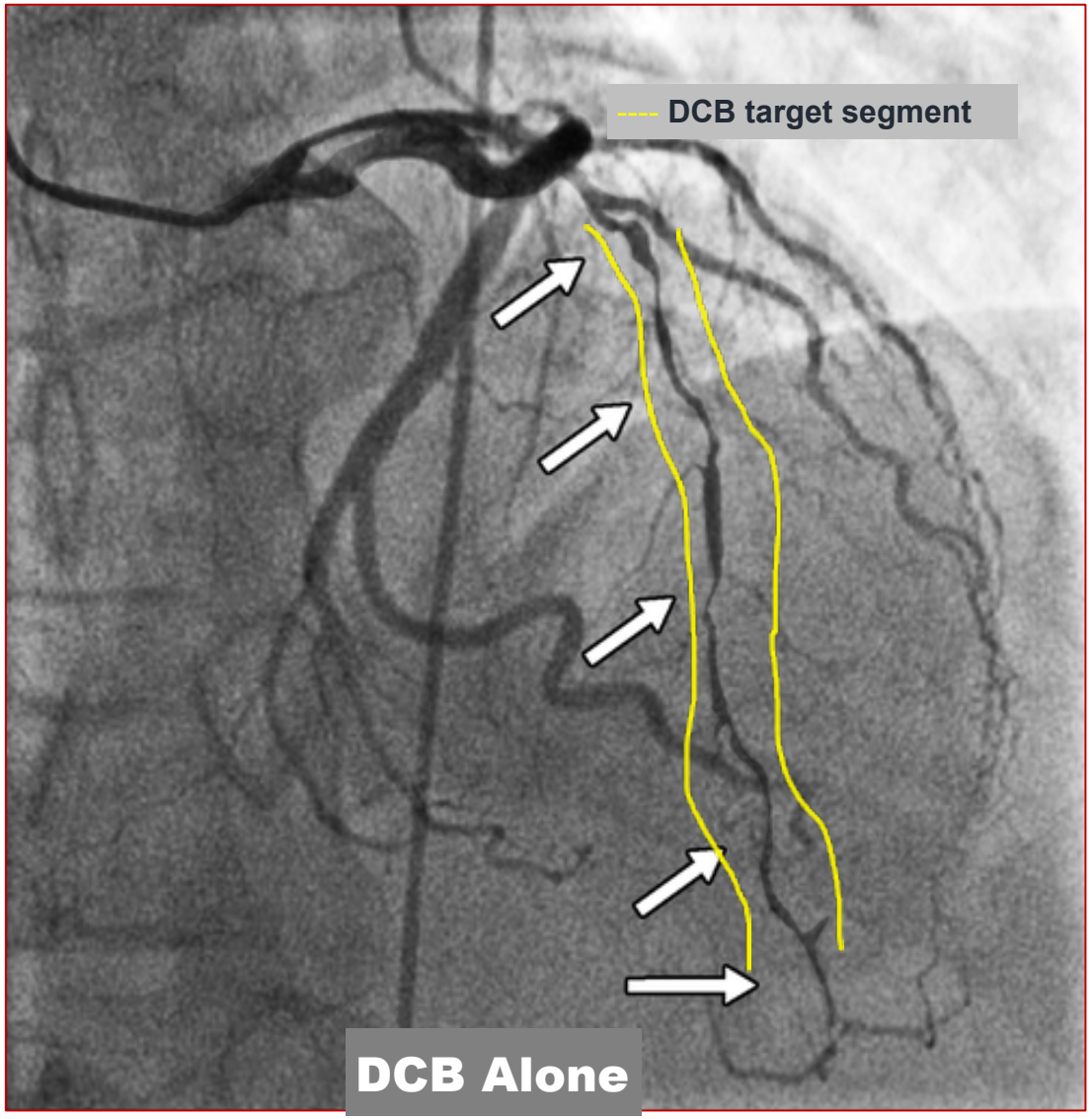
NO

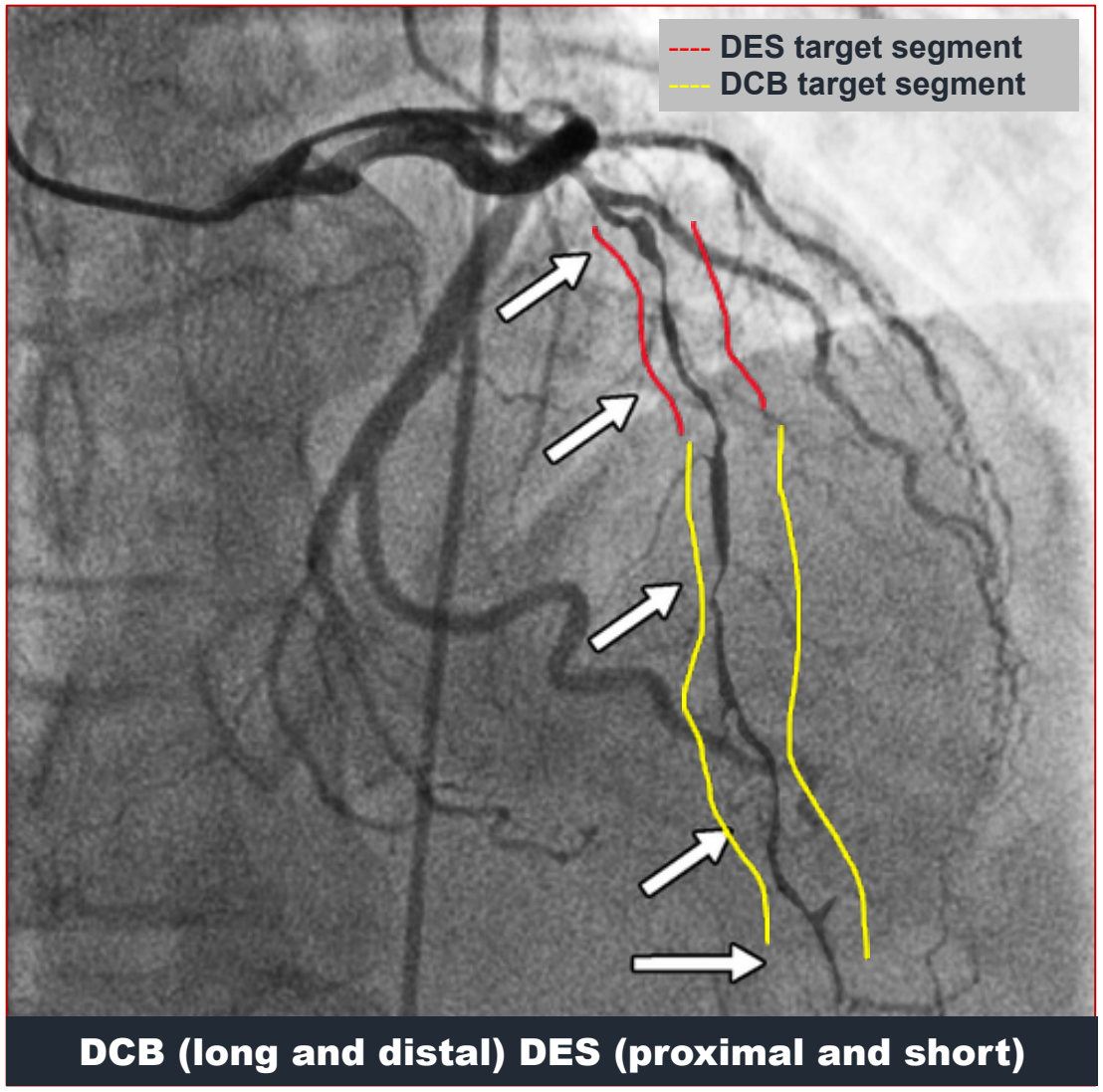
BAIL-OUT DES

FURTHER LESION PREPARATION

Fezzi S et al. J Am Coll Cardiol. 2025 Oct 14;86(15):1170-1202.
Fezzi S et al. Eur Heart J. 2025 Jul 7;46(26):2498-2519.

Which Treatment in This Setting?





Hybrid DES - DCB in Diffuse CAD

DES and DCB

34 long lesions (>25 mm) using hybrid DES/DCB
46.4% **diabetics**
TLR 8.8% (2 cases in the DES-treated segment and 1 case in the DCB-treated segment)
Median follow-up: 26 months

In.PACT Falcon DCB 100% of the cases

BRS and DCB

	Patients, n=42
Procedural success, n (%)	42 (100)
Periprocedural MI (CK MB >5 times the upper limit of normal), n (%)	2 (4.7)
Median follow-up period, months	12 (IQR 6-18)
Angiographic follow-up, n (%)	22 (52.4)
Events from hospital discharge to the longest available follow-up	
All-cause death, n (%)	0
TLR per patient, n (%)	5 (11.9)
ID-TLR per patient, n (%)	2 (4.7)
BRS segment TLR, n (%)	4 (9.5)
BRS segment ID-TLR, n (%)	2 (4.7)
DCB segment TLR, n (%)	1 (2.3)
Definite/probable BRS/DCB segment thrombosis, n (%)	0

In.PACT Falcon DCB 54.7% of the cases

Costopoulos C et al, JACC Intv 2013
Ielasi A et al, Eurointervention 2016

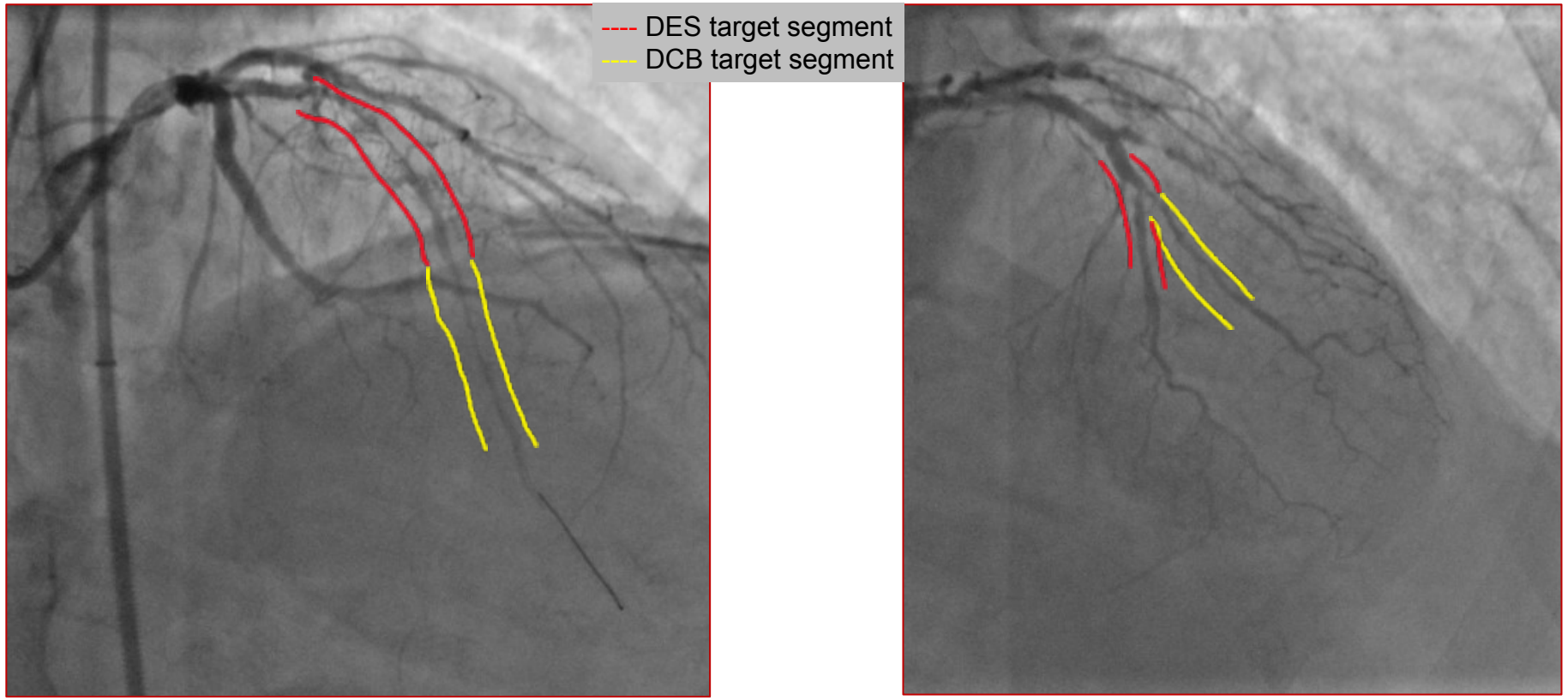
I.R.C.C.S. Ospedale Galeazzi - Sant'Ambrogio
Gruppo San Donato

HYPER

PLACE 2026
PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

A Hybrid Approach Evaluating a Drug-Coated Balloon in Combination with New Generation Drug-Eluting Stent in the Treatment of De Novo Diffuse Coronary Artery Disease: ***The HYPER Pilot Study***

NCT03939468



"**Hybrid strategy**": overlapping or slightly (2-3 mm) superimposing a new generation DES implanted in the larger –RVD>2.75 mm-, more proximal part of the vessel or in the MB of a bifurcation, and DCB inflation for a contiguous small vessel disease (RVD ≥ 2.0 mm to ≤2.75 mm) located in the distal segment or at a SB of a bifurcation.

RESTORE

Paclitaxel-Coated Balloon

Excipient

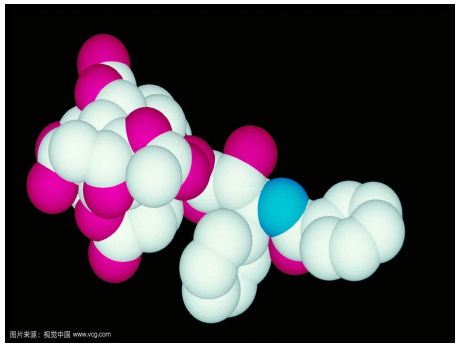
Amorphous coating (**SAFEPAX matrix**) based on shellac-ammonium salt (hydrophobic and lipophilic)

RESTORE lipophilic amorphous coating

Hydrophilic crystalline coating (other DCBs)

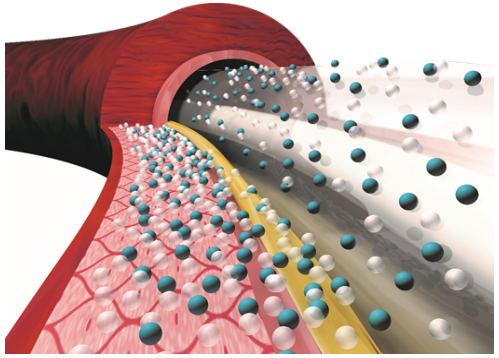
Drug

Paclitaxel 3.0 µg/mm²



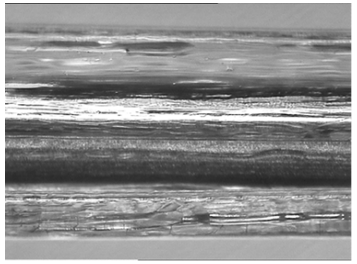
Particle Size

Smaller compared other DCB



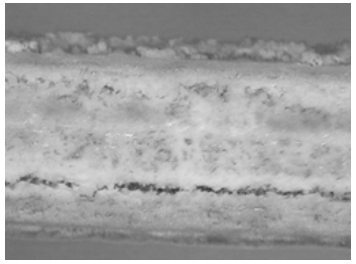
Balloon Diameter: 2.0 mm to 4.0 mm
Balloon Length: 15 mm to 30 mm

Optical Image Measuring (100x)



RESTORE DEB

Transparent & bendable coating with smooth morphology



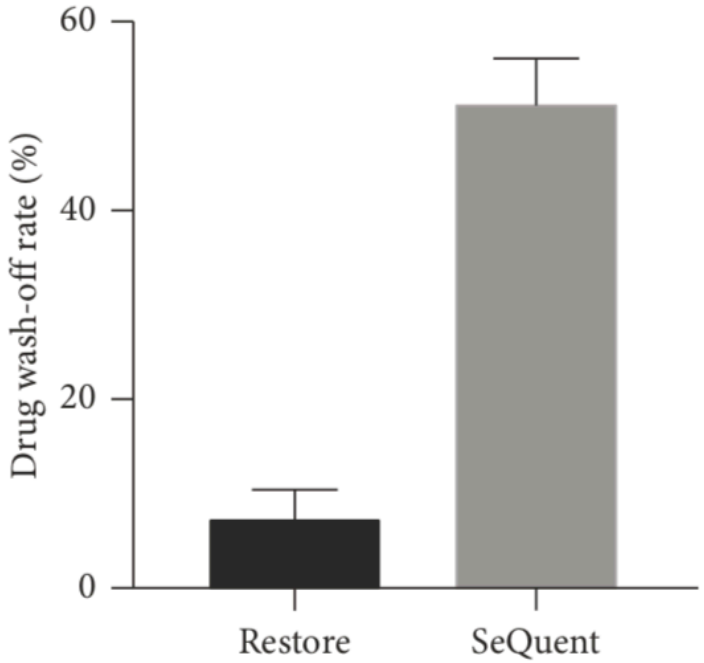
OTHER DCB

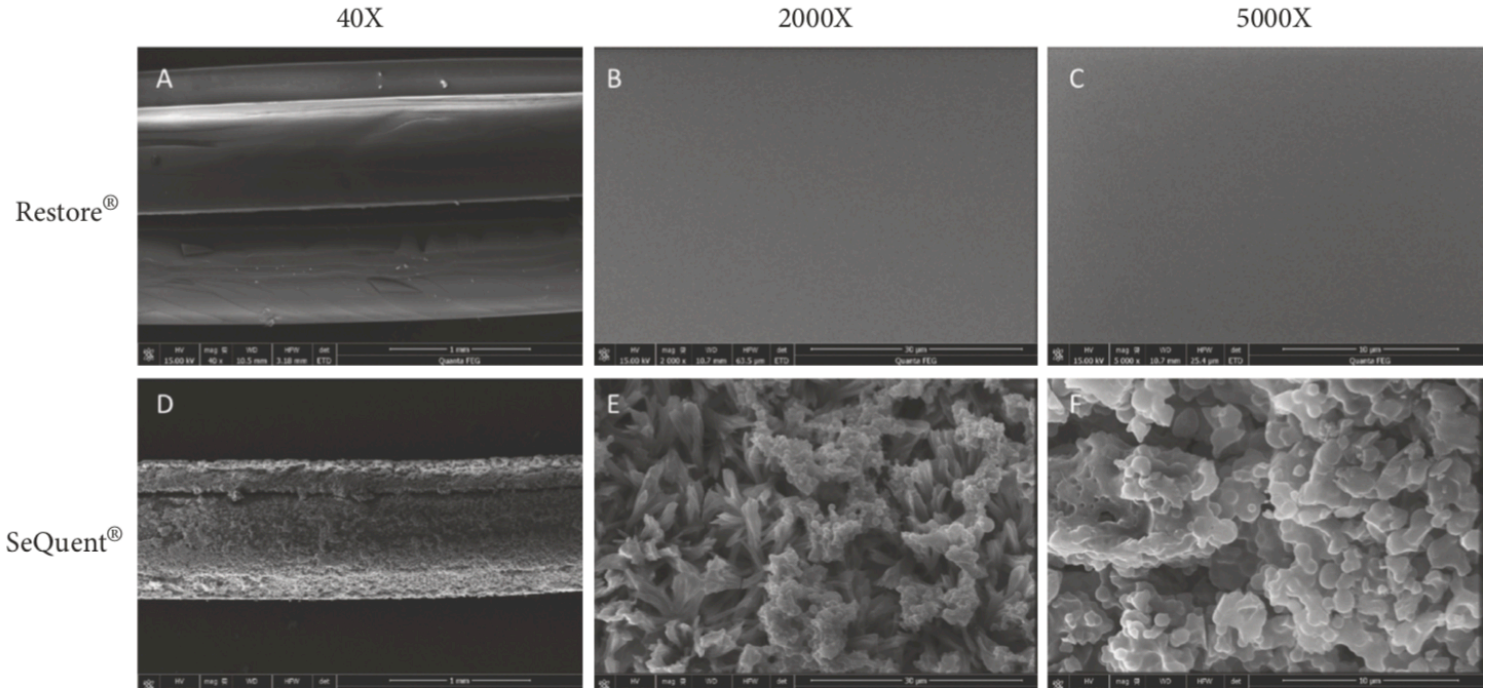
Other Hydrophilic Coating

RESTORE vs. Sequent Please

In-Vitro Comparison

n=16 lesions evaluated





Restore DCB surface smoother and evenly distributed with hardly visible crystal vs. SeQuent® DCB (rougher surface with relatively larger apparent crystals)

Xia C et al J Interv Cardiol 2021

HYPER

Technical Aspects

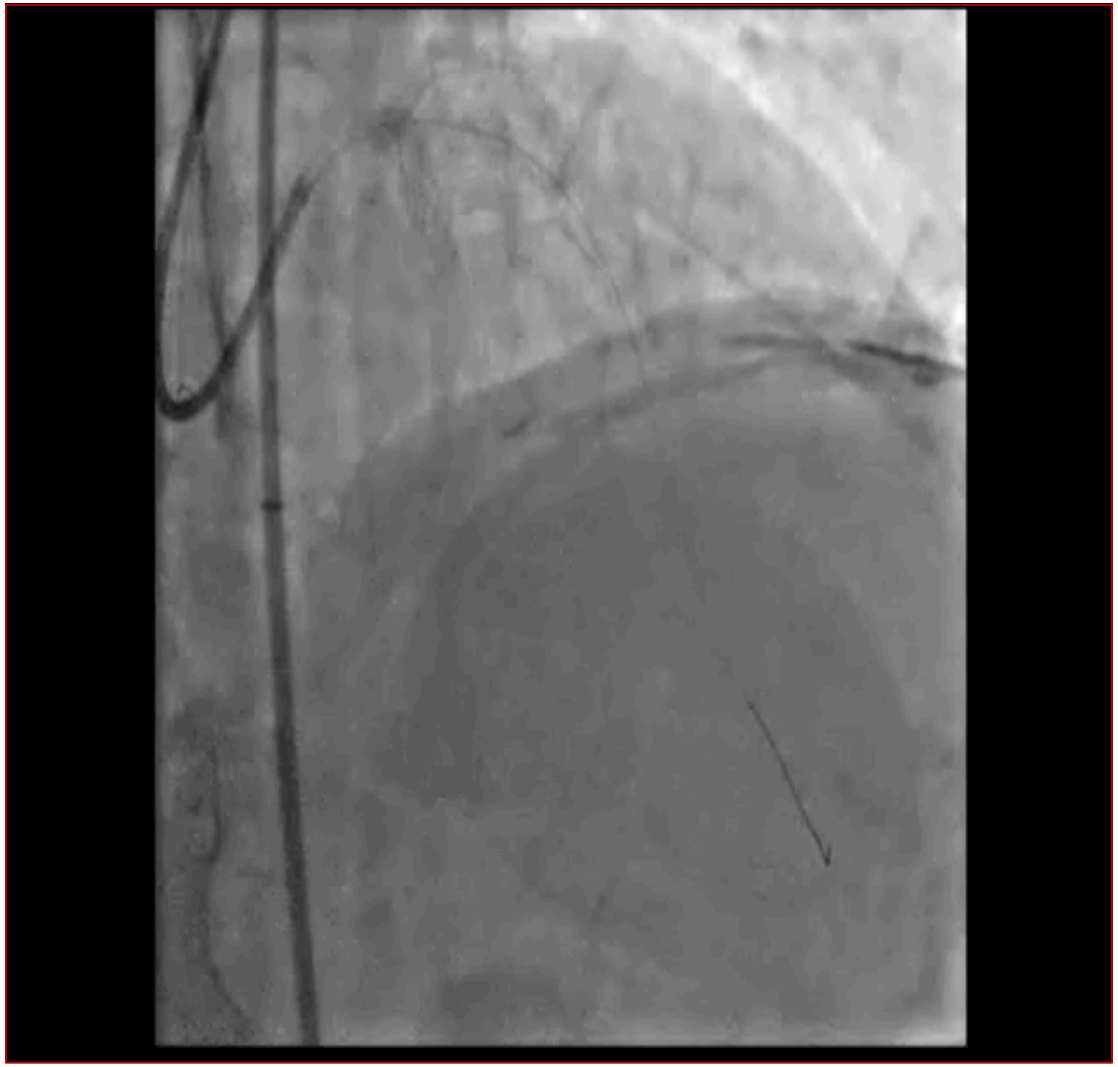
- **Successful pre-dilatation mandatory** (balloon-to-artery ratio 1:1) → goal: %DS <30% (QCA or visual)
- DCB (length> 2mm than the pre-dil balloon length) prolonged inflation (30-60 seconds minimum)
- DCB distally – DES proximally or reverse as per operator's preference
- **Leave untreated type A-B dissection in the DCB target site**
- Bail-out stenting in the DCB treated segment in case %DS>30% or type C-F dissection
- DES every brand accepted
- **DCB**: **Restore** Cardionovum
- DAPT at least 1 month (according to pt clinical features)

HYPER

HYPER

Long Lesion (2019)

73 yrs old male, NIDDM
Effort angina (CCS 3)



Successful pre-dil SC 2.0 mm (14 atm) then NC 2.5 mm distally and 3.0 mm proximally@20 atm

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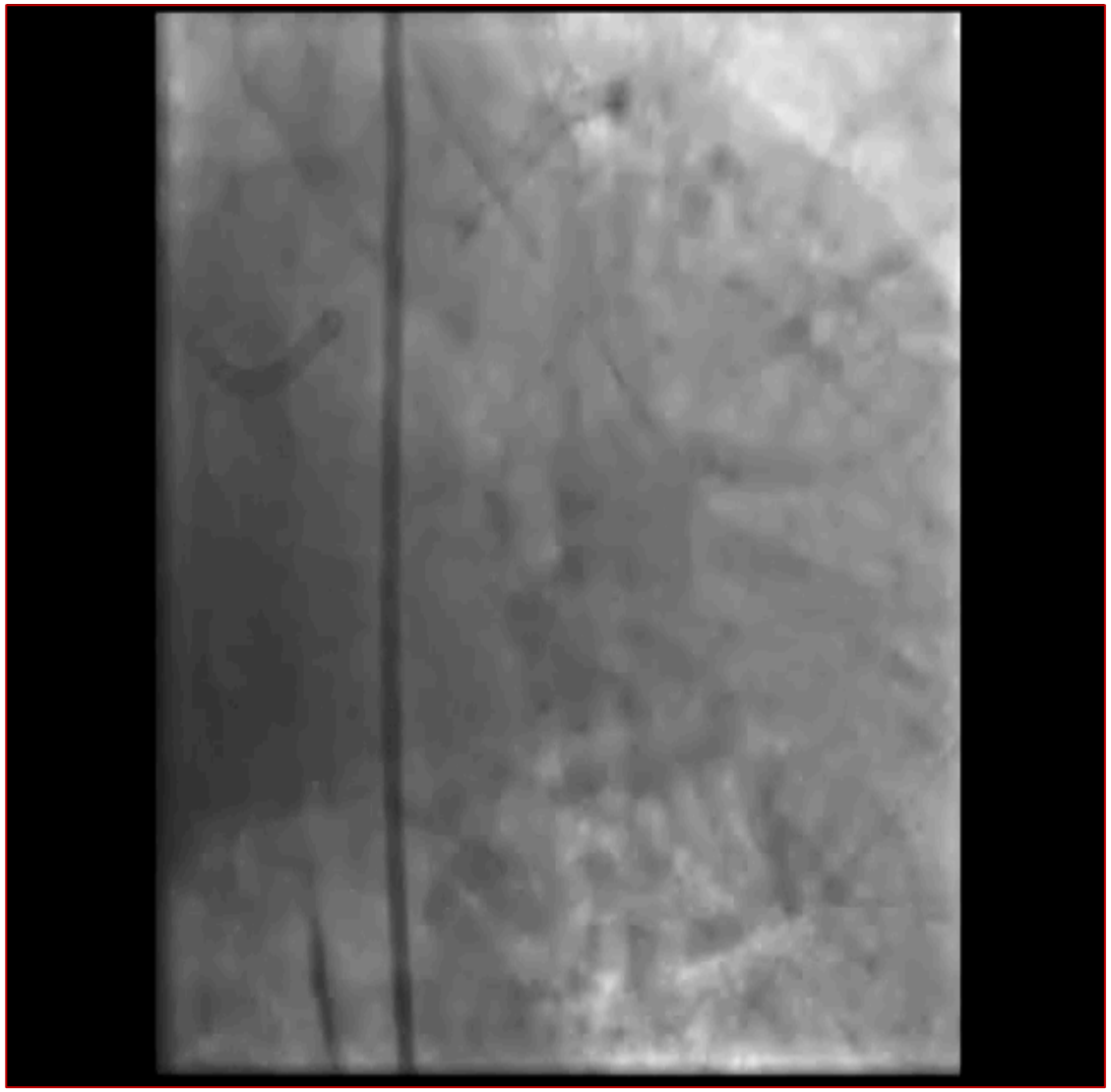
Long Lesion (2019)

Hybrid DES/DCB LAD DES (3.0x34 mm) mid-prox LAD and Restore x2 (2.5x30 mm) distal LAD



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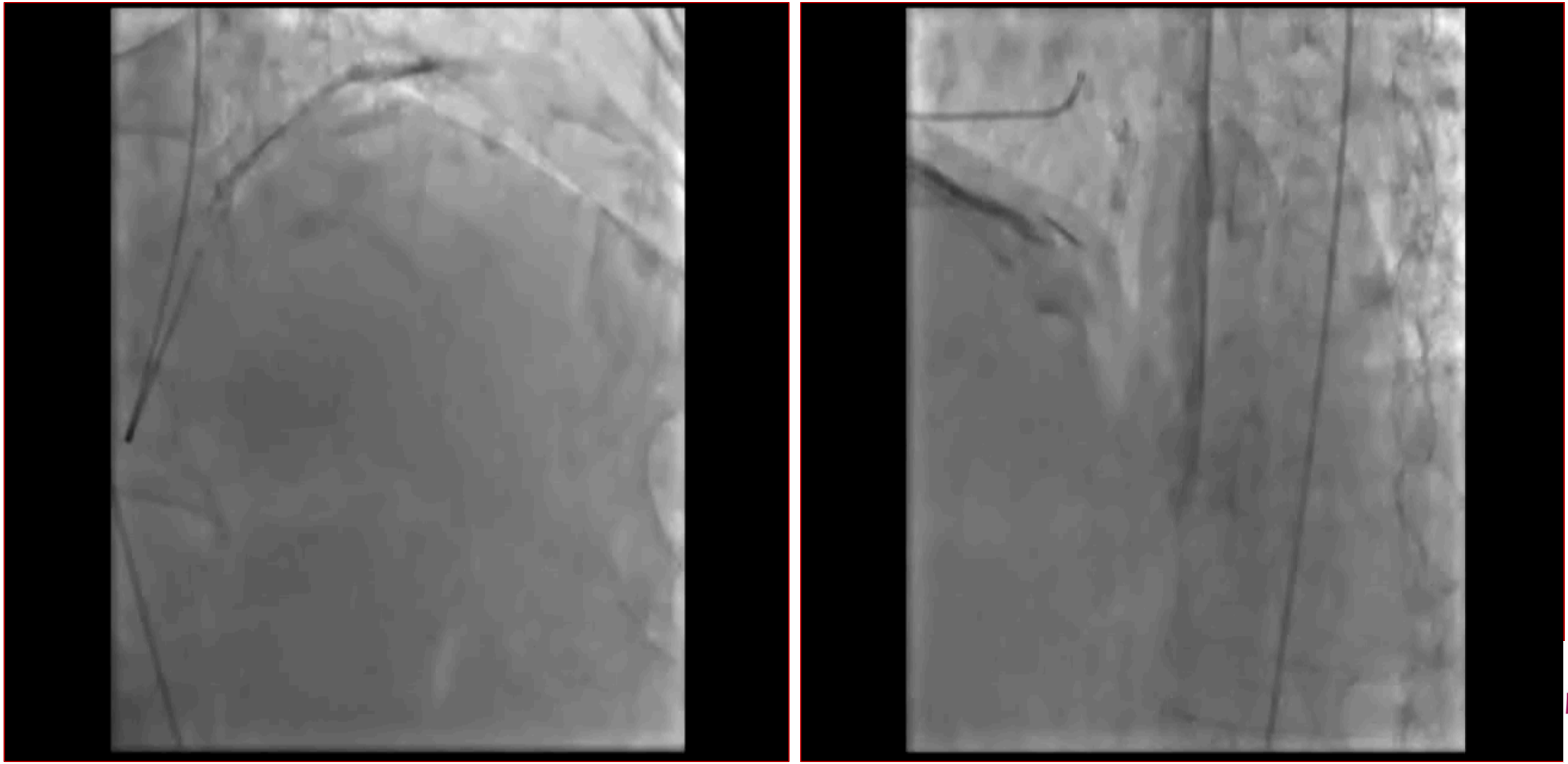
PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

5-Year (2024) Long Lesion Hybrid DES-DCB Follow-up



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Hybrid DES Restore DCB in Diffuse CAD

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	Lesions (n=106)
LAD target vessel, n (%)	55 (51.8)
Long lesions, n (%)	56 (52.8)
Pre-dilatation, n (%)	106 (100)
Pre-dil NC balloon (DCB target), n (%)	65 (61.4)
DES diameter (mm), mean ± SD	2.99±0.51
DES length (mm), mean ± SD	29.1±9.6
DCB diameter (mm), mean ± SD	2.37±0.39
DCB length (mm), mean ± SD	22.6±6.7
DCB distally then DES proximally	48 (85.8)

Patients	n=106
In-hospital Outcome	
Procedural success, n (%)	102 (96.2)
Peri-procedural MI, n (%)	3 (2.8)
Flow-limiting dissection requiring stenting, n (%)	3 (2.9)
DCB did not reached the target lesion, n (%)	1 (0.9)
Major bleeding (according BARC classification)	3 (2.8)
2-Year Outcome	
Device-oriented composite end-point, n (%)	4 (4.6)
Cardiac death, n (%)	1 (0.9)
Target vessel MI (excluding periprocedural MI), n (%)	0 (0)
Overall ID-TLR, n (%) ID-TLR DES target segment, n (%) ID-TLR DCB target segment, n (%)	4 (3.7) 1 (0.9) 3 (2.8)
Thrombosis at the DCB or DES target segment	0 (0)

Ielasi A et al *Minerva Cardioangiol* 2023

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Gruppo San Donato

HYPER II

PLACE 2026
PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

NCT05650450

A Hybrid Approach Using A Drug-Coated Balloon in Combination With A New Generation Drug-Eluting Stent in the Treatment of Long Diffuse De Novo Coronary Artery Disease: The HYPER II Study

Study Design	Prospective, single-arm, multicenter registry

Primary end-point:

Target lesion failure (TLF) defined as a composite of cardiac death, target vessel myocardial infarction (TV-MI) and ischemia-driven target lesion revascularization (ID-TLR) in the DES- and/or the drug-coated balloon (DCB)-treated segment within 12 months after the index procedure.

generation DES for a de **novo long (>38 mm) lesion** (located in the larger, more proximal part of the vessel -reference vessel diameter -RVD >2.75 mm-) and DCB inflation for a concomitant and contiguous de novo small vessel disease (distally located with RVD ≤2.75 mm).

Principal Investigator: Alfonso IELASI, MD FESC

I.R.C.C.S. Ospedale Galeazzi - Sant'Ambrogio
Gruppo San Donato

HYPER II

Global Study

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PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

Target
n= 500 patients

- Italy
- Bulgaria
- Poland
- Croatia
- U.K.
- Malaysia
- Iran

n= 270 pts enrolled

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HYPER II

Case Example

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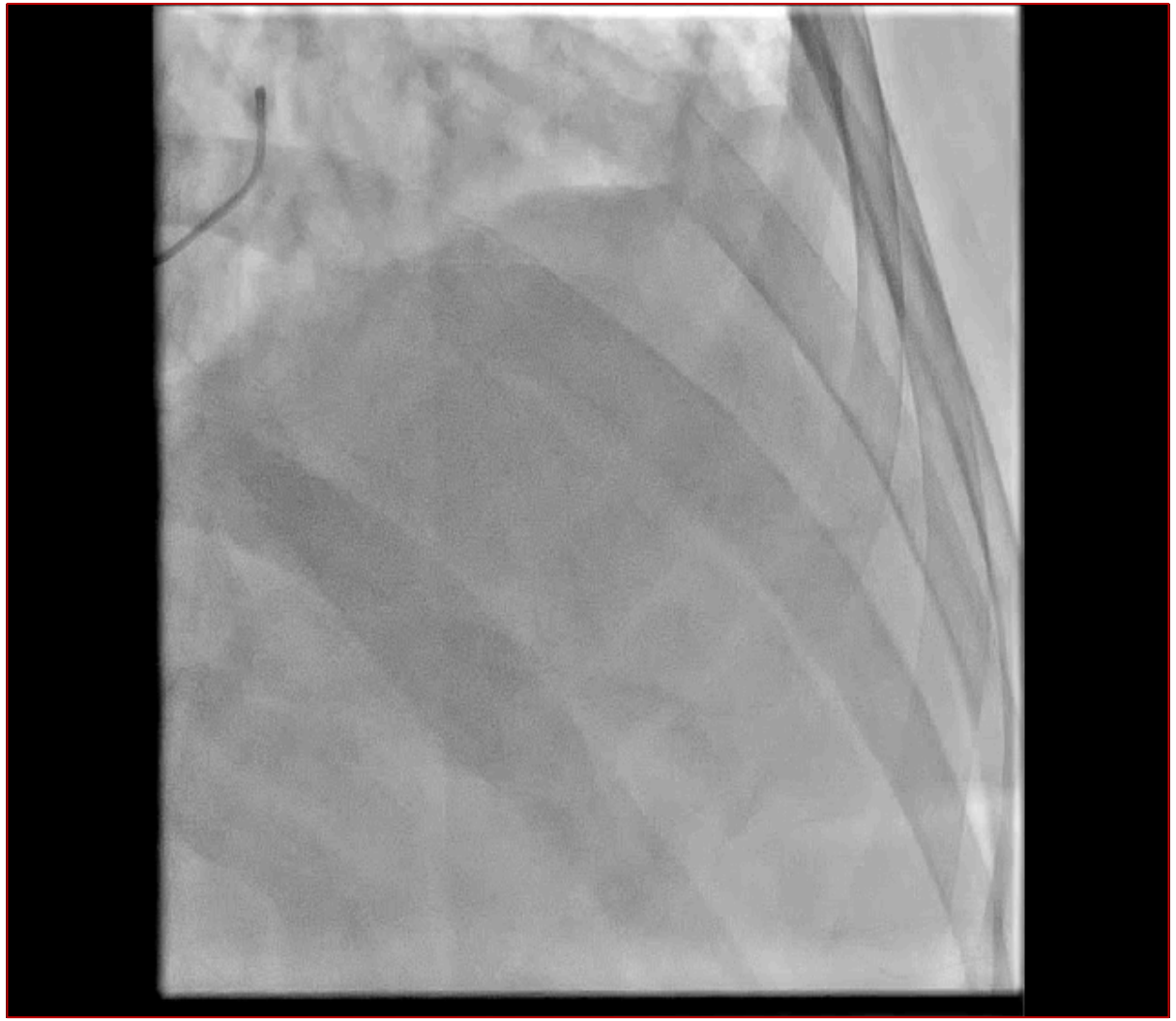
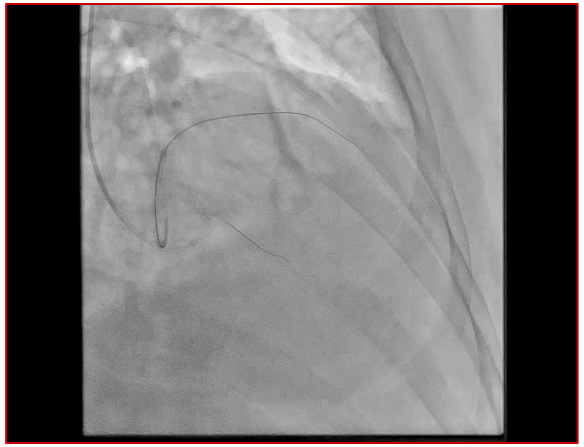
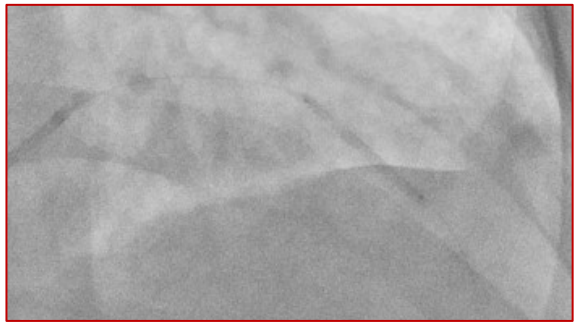
61 yrs old male, NIDDM
Obese: BMI 39 kg/m^2
Effort angina (CCS 3)
LVEF 40%, anterior wall hypkinesia

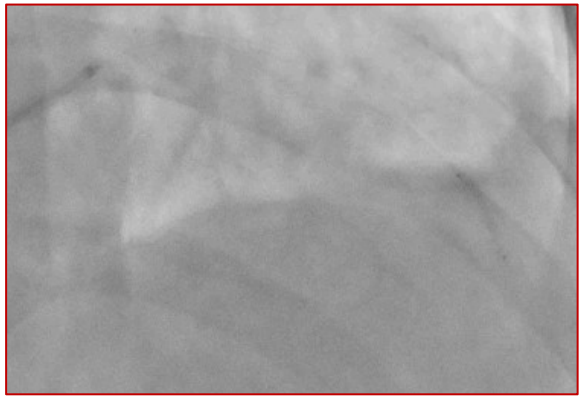


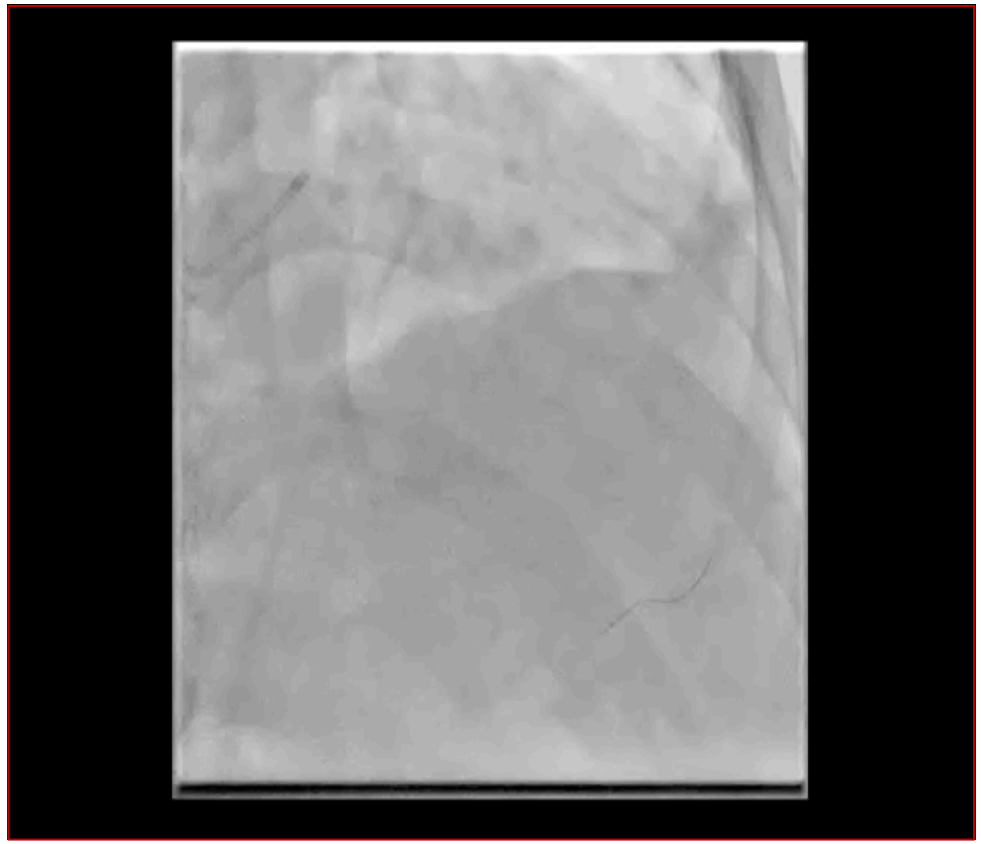
HYPER II

LAD after predilation







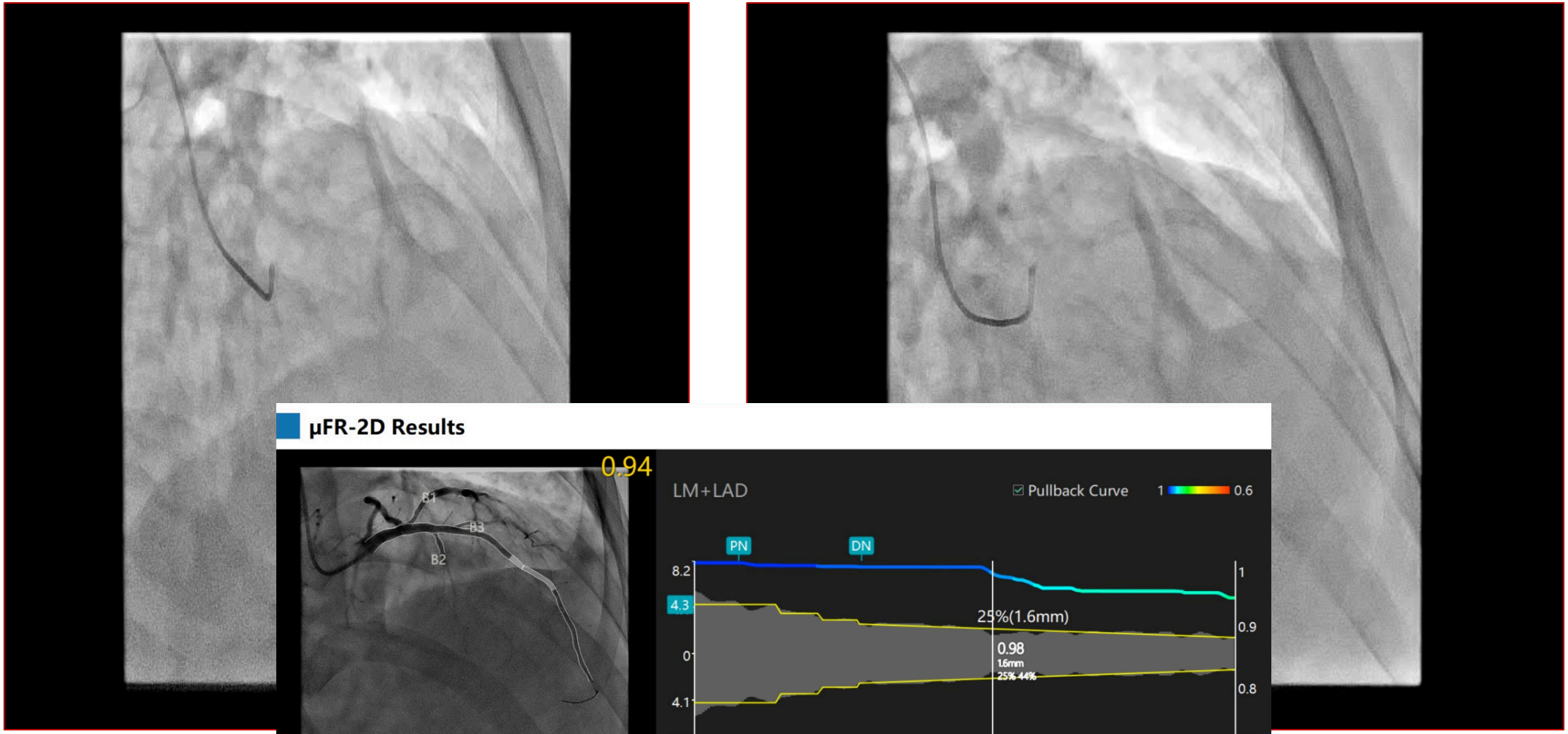


Multiple inflations: SC 1.25 mm at 18 atm; SC 2.0 mm at 14 atm, NC 2.5 mm at 14 atm

HYPER II

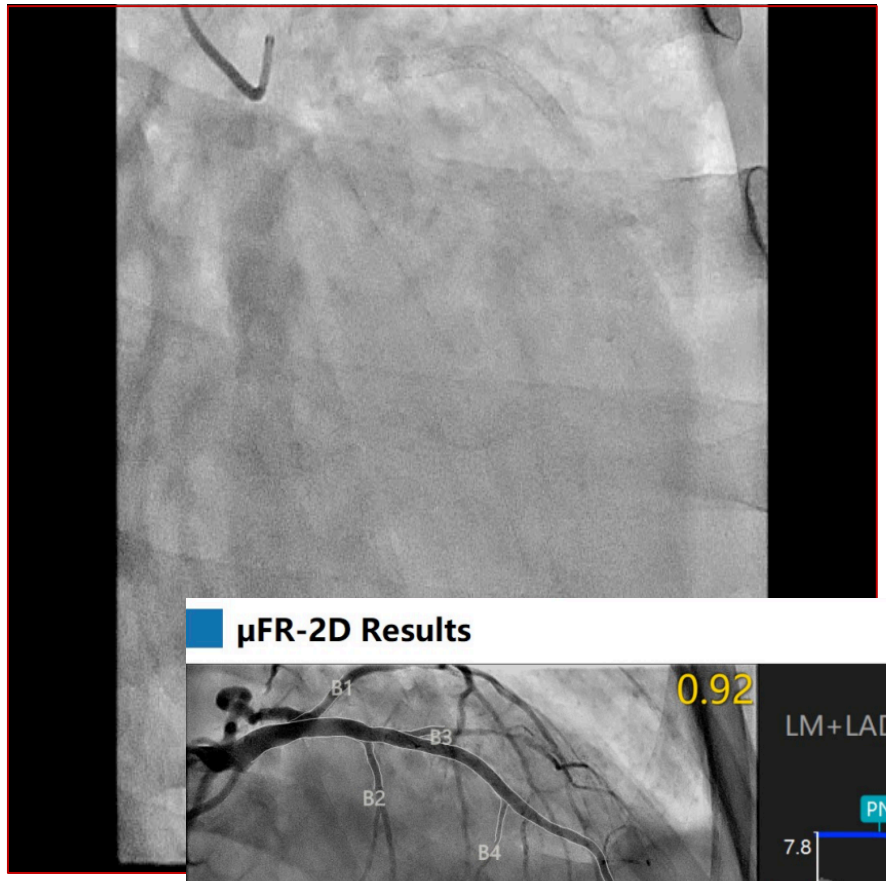
Final result after Hybrid DES – DCB on LAD

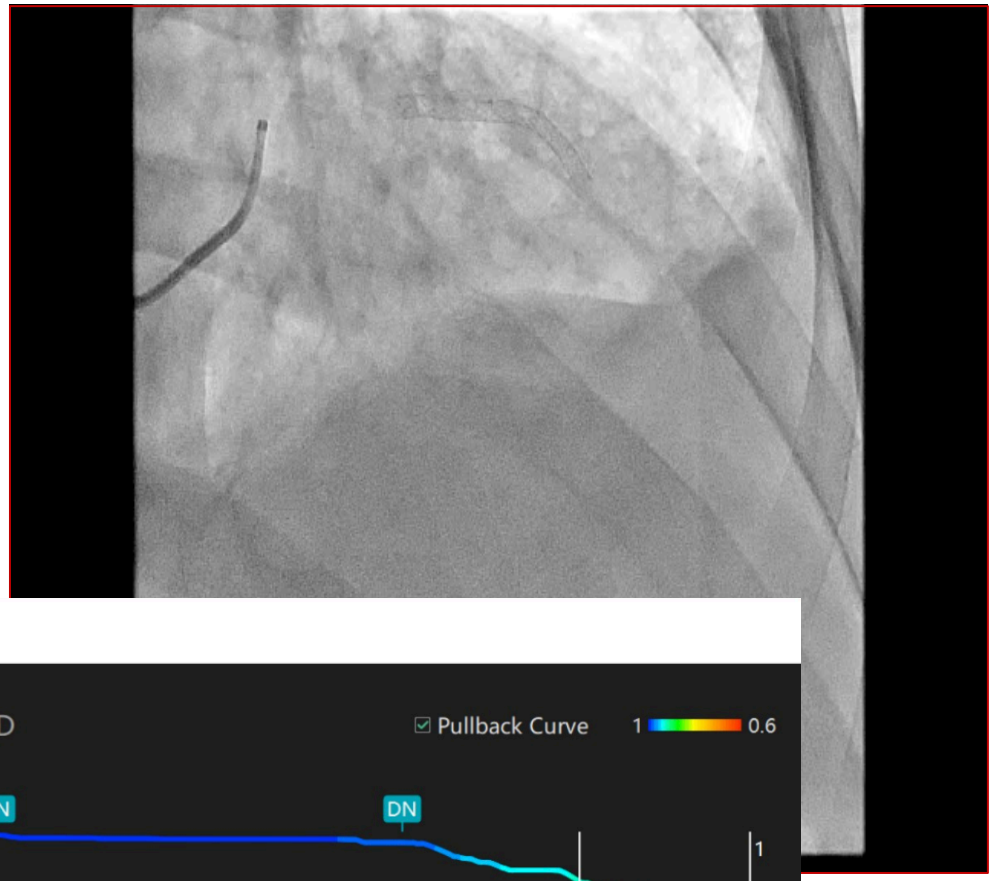
DES 3.0x34 mm mid LAD, Restore (x2) 2.0x30 mm and 2.5x30 mm. mm on mid-distal LAD

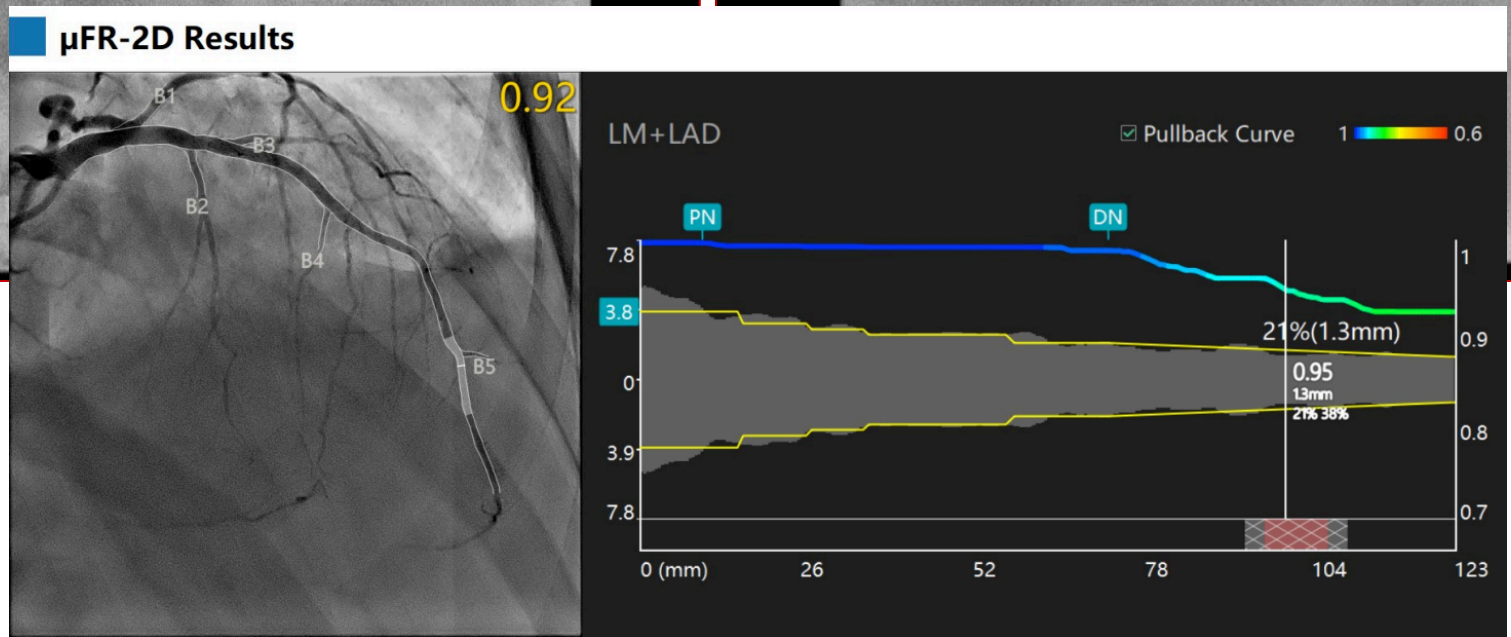


HYPER II

9-Months FU Hybrid DES – DCB on LAD







I.R.C.C.S. Ospedale Galeazzi - Sant'Ambrogio
Gruppo San Donato

HYPER II

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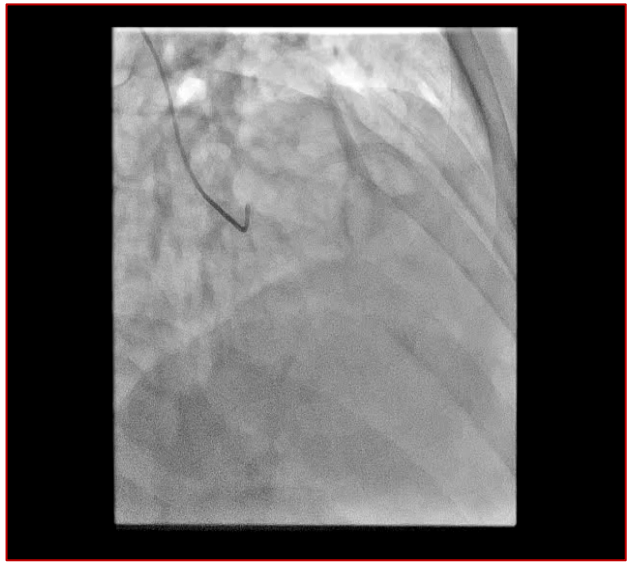
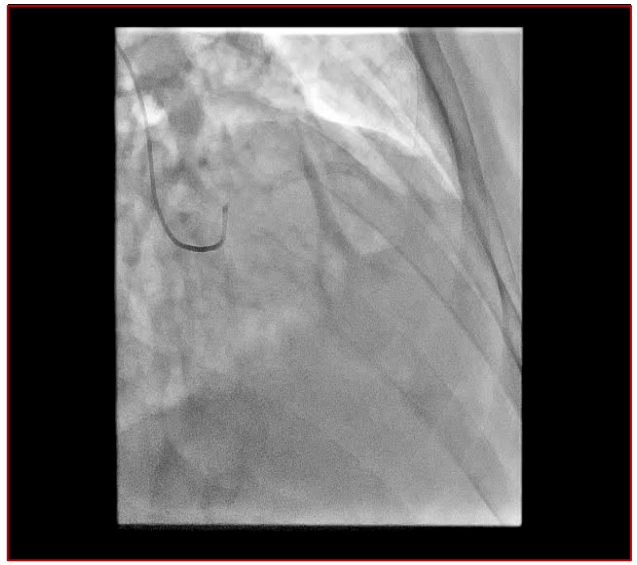
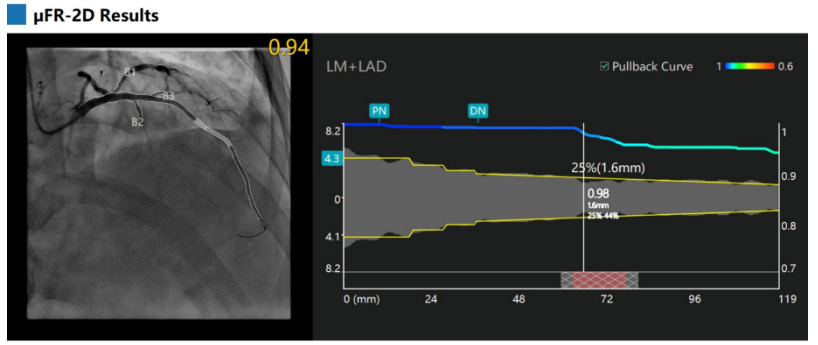
Index vs. 9-Months FU Hybrid DES – DCB on LAD

Final Index Procedure

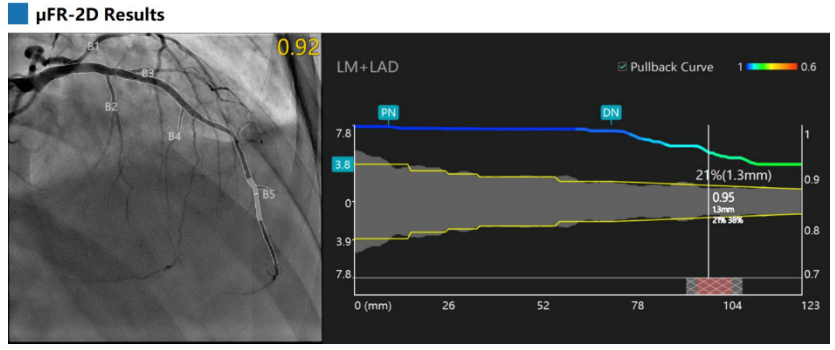






QCA DCB Tarhet Segment	Index	9-Month F-up
LAD mid-dist MLD, mm	2.51	2.64
LAD distal mid-dist DS, %	5.89	6.01
LAD distal MLD, mm	2.46	2.61
LAD distal DS, %	6.32	6.54

9-Months Follow-up



Conclusions

- The "HYPER" hybrid approach (DES -proximal segments RVD>2.75 mm- in overlap with Restore PCB -distal segments-RVD≥ 2.0 mm to ≤2.75 mm) is associated with high procedural success rate and low incidence of DOCE up to 2 years follow-up;
- A hybrid approach (SCB and PCB) is associated with lower TLF vs. DES only PCI in long LAD lesions
- Functional (non invasive/invasive) assessment might help to better assess the DCB PCI efficacy
- Hybrid DES/DCB PCI as intention helpful strategy to manage diffuse CAD involving segments with different RVDs ("large " and "small" vessels)

Thank You!

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