Strategic decision-making PCI in ischemic cardiomyopathy

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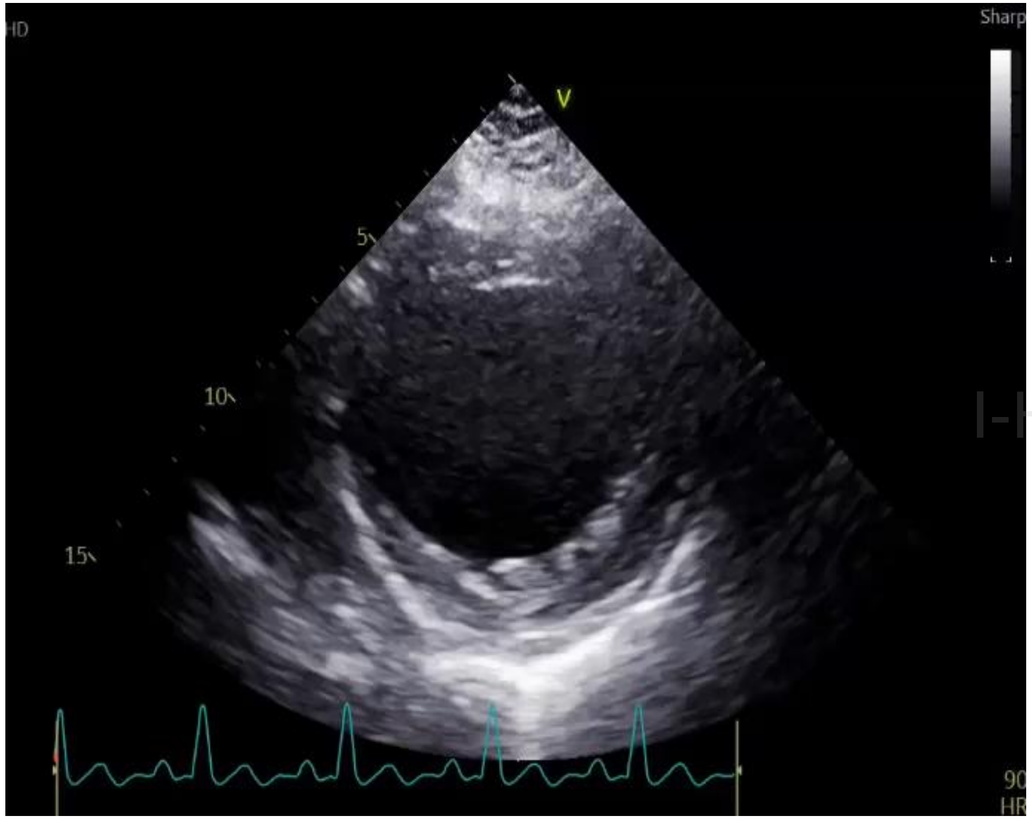
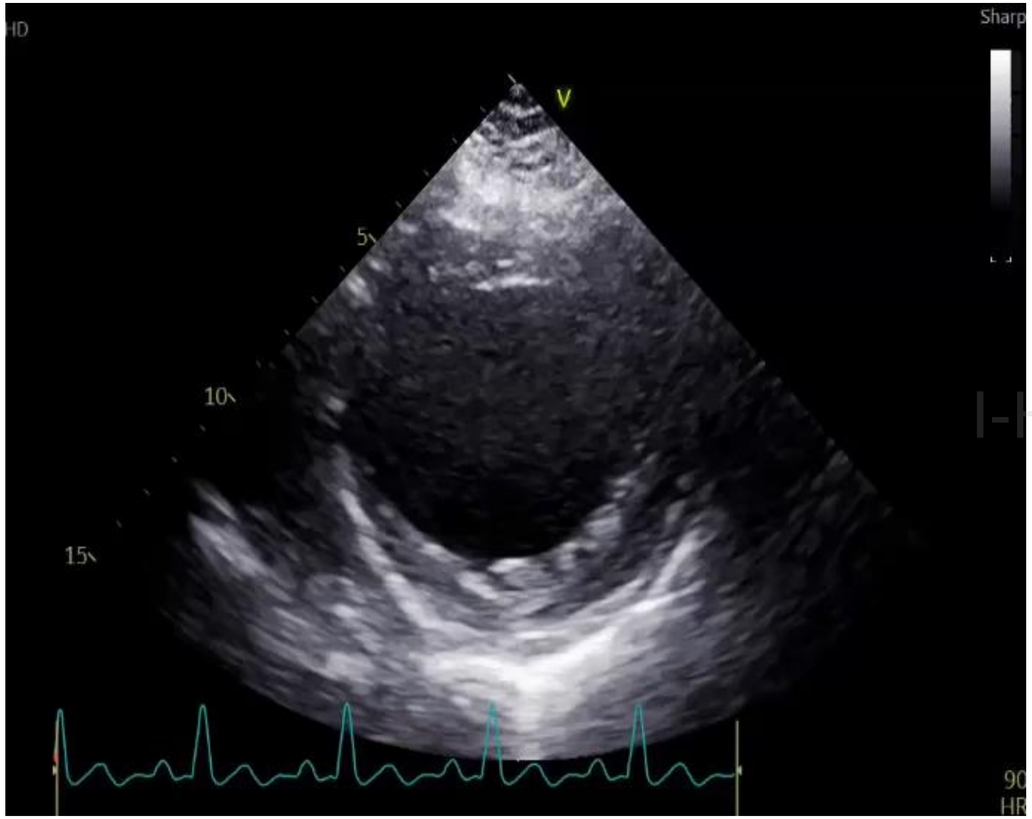
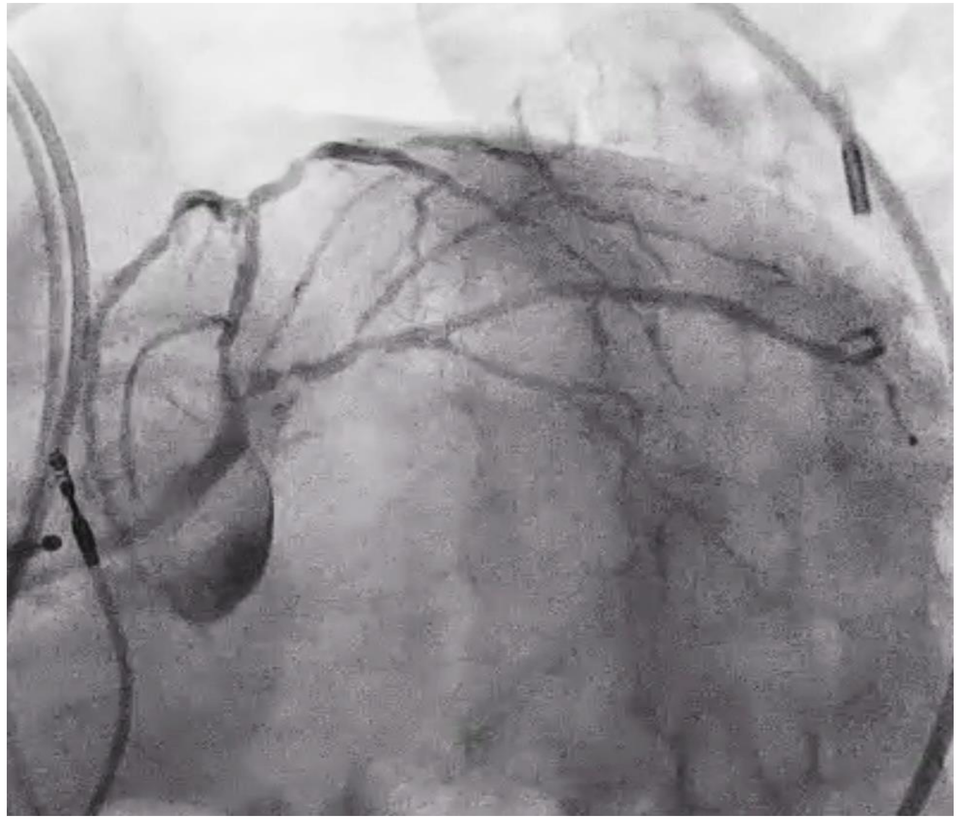
Dilated Cardiomyopathy

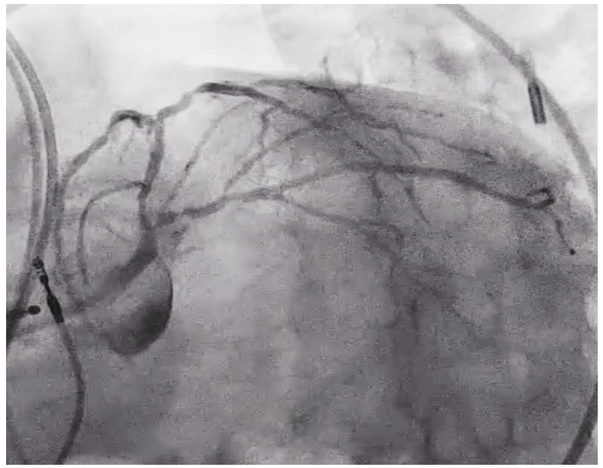


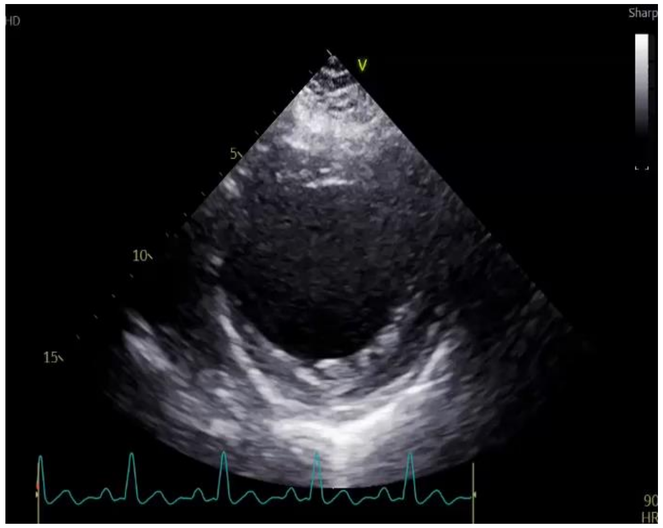
“Ischemic” Cardiomyopathy





Ischemic Cardiomyopathy : The Hope





- **Recovery in regional function**
- **Reduced ventricular remodeling**
- **Prevented ventricular arrhytmia**

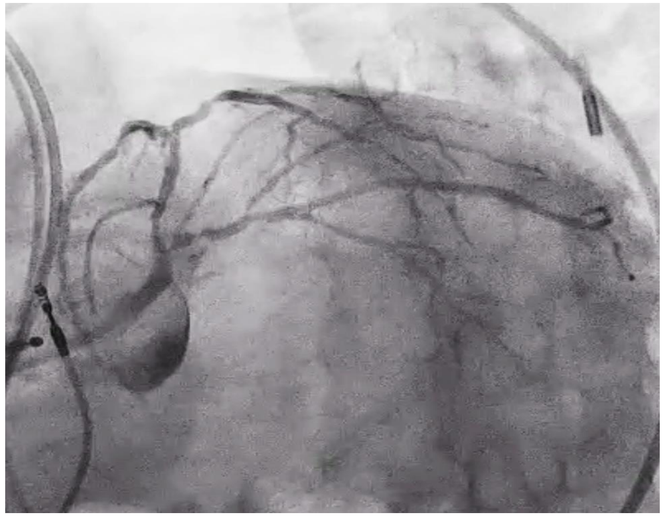
Treatment

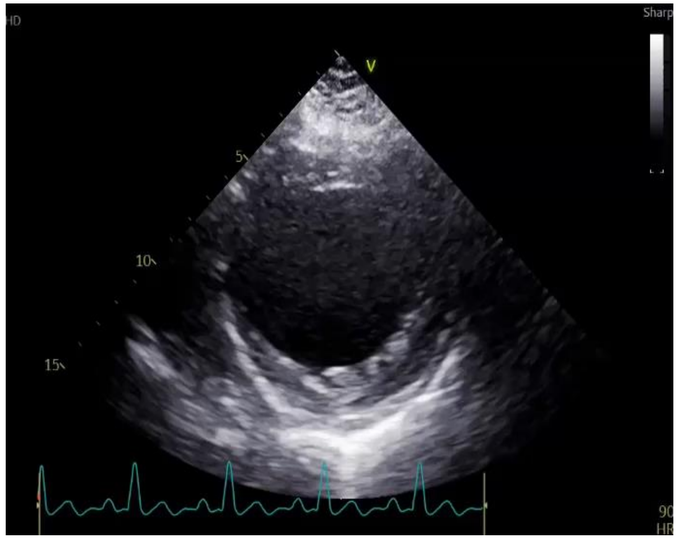
- **Reduced ischemia and repetitive stunning**
- **Prevented MI**

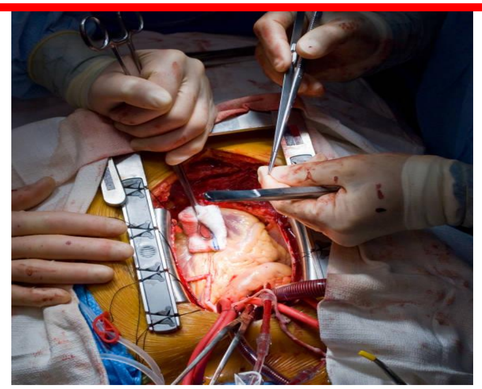
Better Prognosis

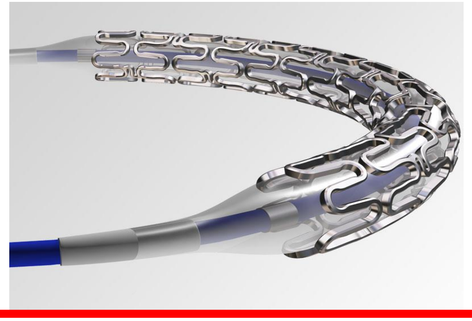
Relieve the Symptoms

The treatment option of Ischemic Cardiomyopathy









But…… ?

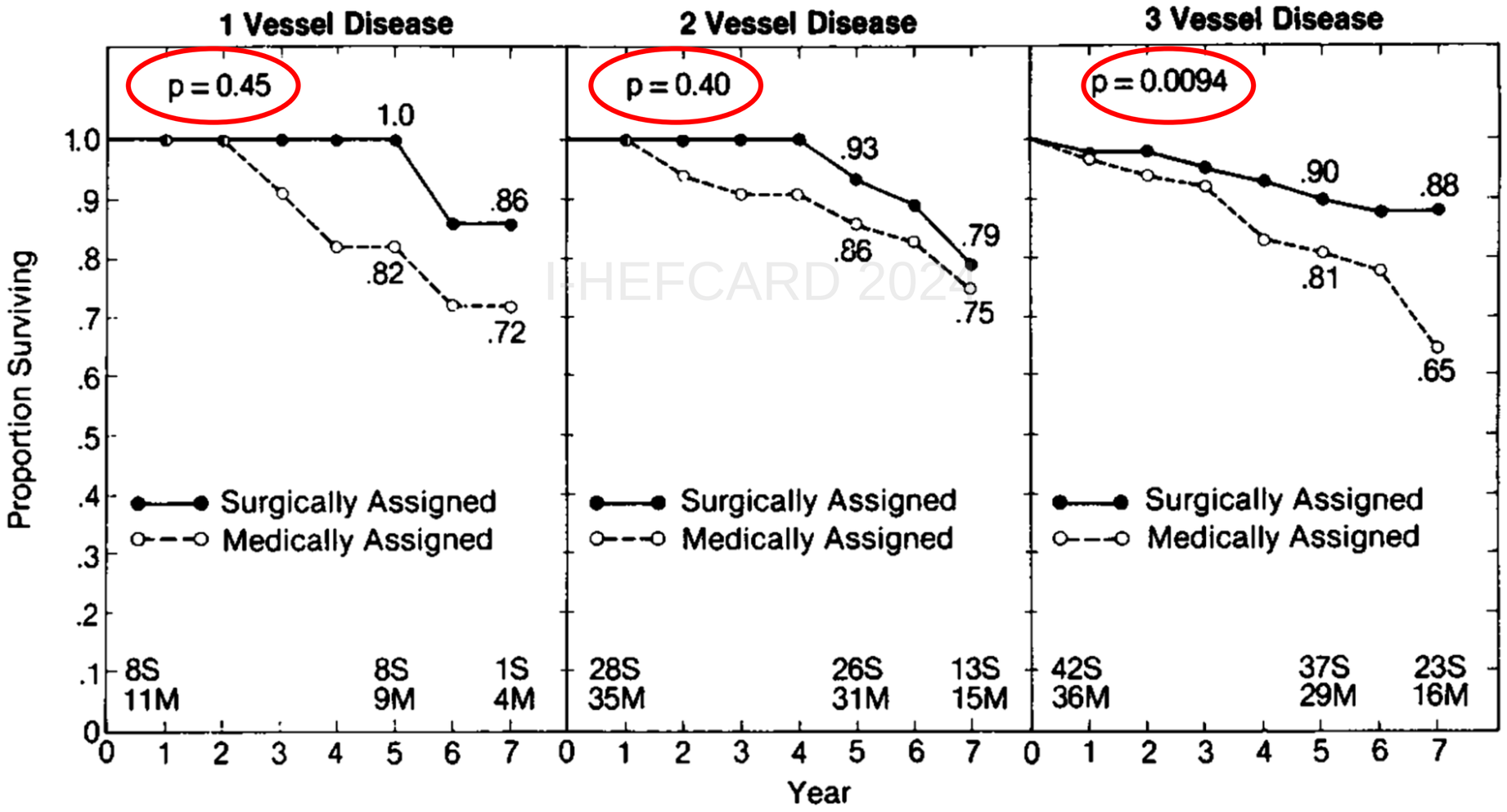
The Treatment Option in Ischemic Cardiomyopathy

Revascularization

Medical Treatment Only

Survival in Patients with LV dysfunction

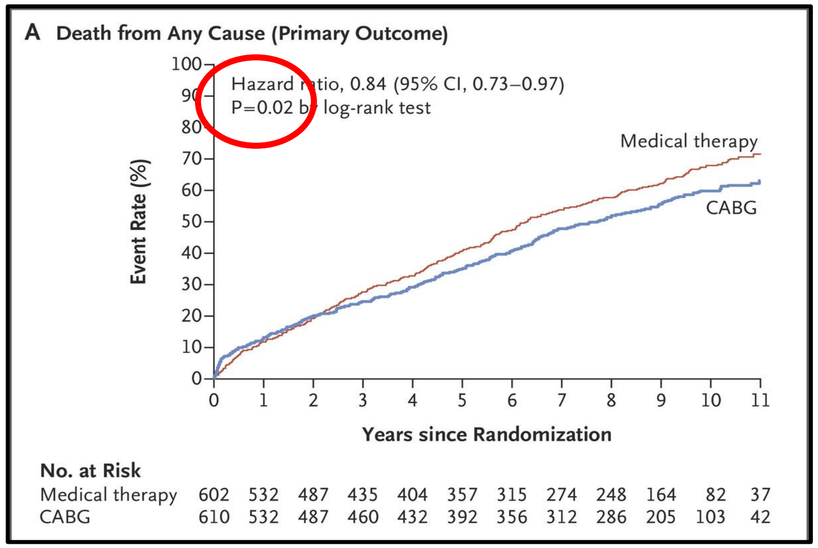
CASS Randomized Trial

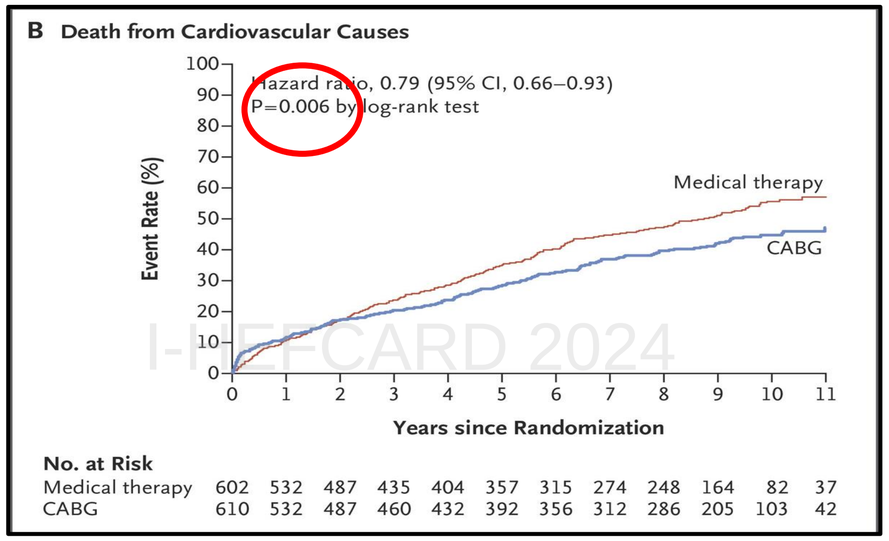


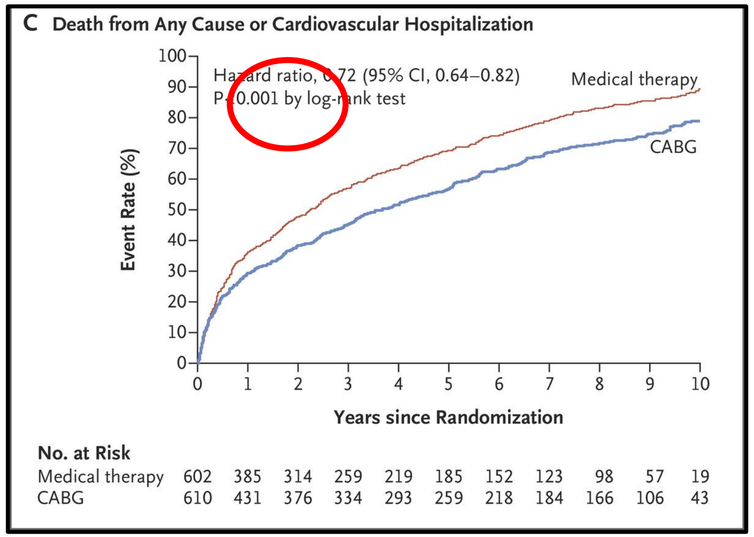
N Engl J Med 1985 Jun 27;312(26):1665-71.

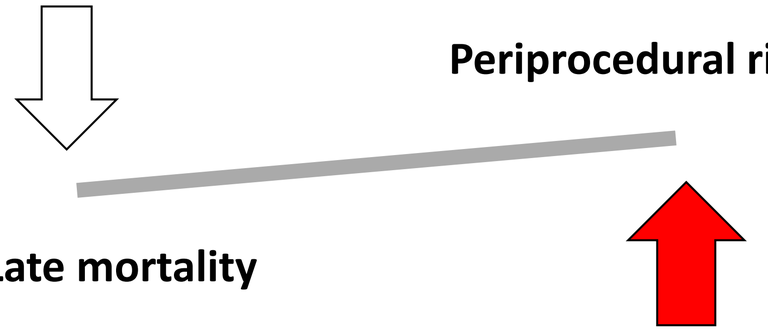
STICH trial – 10 Year Outcome

1212 pts, LVEF ≤ 35%



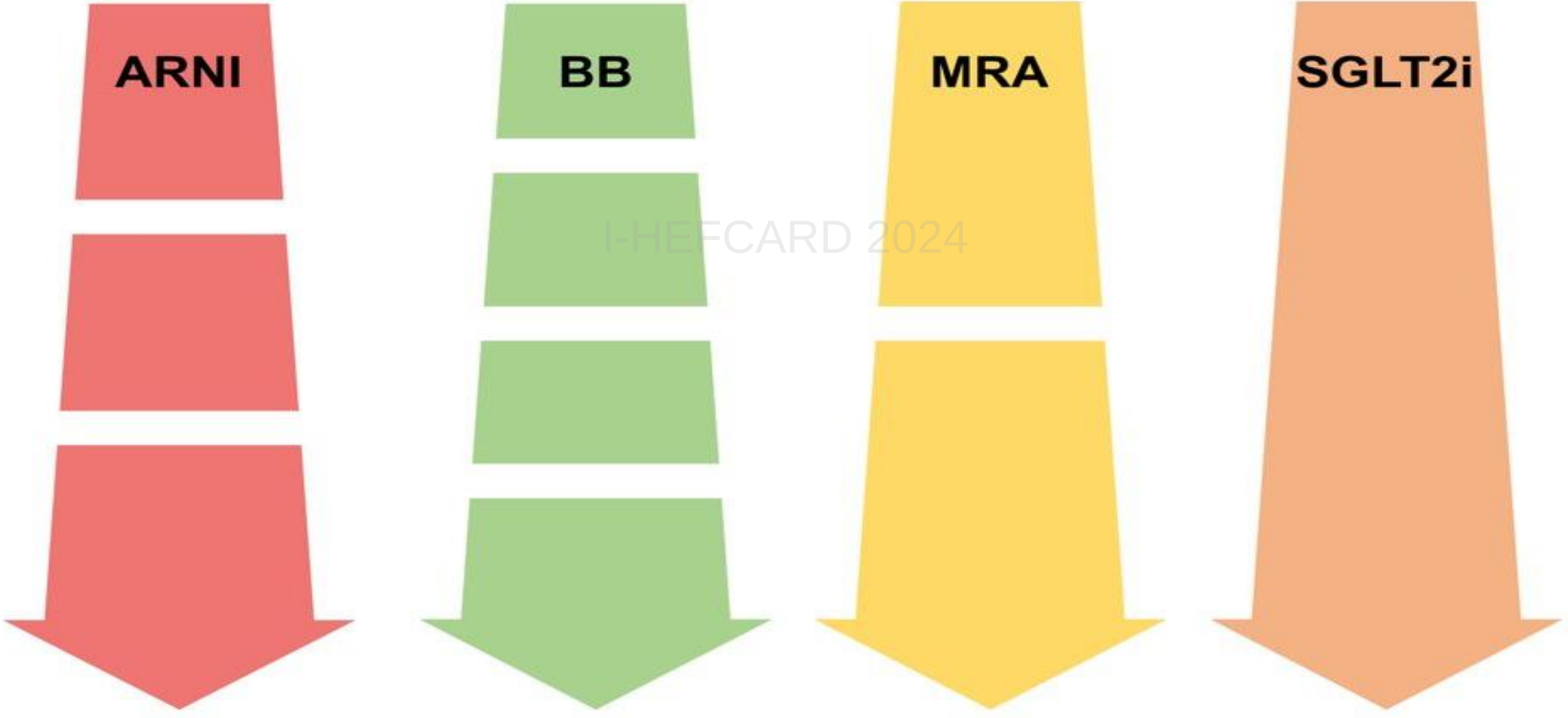






N Engl J Med 2016;374:1511-1520.

The Four Pillars of Heart Failure



PCI No Better Than GDMT in Ischemic Cardiomyopathy: REVIVED-BCIS2

PCI should not be undertaken to treat and improve left ventricular dysfunction, says Divaka Perera.

by Michael O'Riordan | AUGUST 27, 2022

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 OCTOBER 13, 2022 VOL. 387 NO. 15

Percutaneous Revascularization for Ischemic Left Ventricular Dysfunction

Divaka Perera, M.D., Tim Clayton, M.Sc., Peter D. O'Kane, M.D., John P. Greenwood, Ph.D., Roshan Weerackody, Ph.D., Matthew Ryan, Ph.D., Holly P. Morgan, M.B., B.Ch., Matthew Dodd, M.Sc., Richard Evans, B.A., Ruth Canter, M.Sc., Sophie Arnold, M.Sc., Lana J. Dixon, Ph.D., Richard J. Edwards, Ph.D., Kalpa De Silva, Ph.D., James C. Spratt, M.D., Dwayne Conway, M.D., James Cotton, M.D., Margaret McEntegart, Ph.D., Amedeo Chiribiri, Ph.D., Pedro Saramago, Ph.D., Anthony Gershlick, M.D., Ajay M. Shah, M.D., Andrew L. Clark, M.D., and Mark C. Petrie, M.D., for the REVIVED-BCIS2 Investigators*

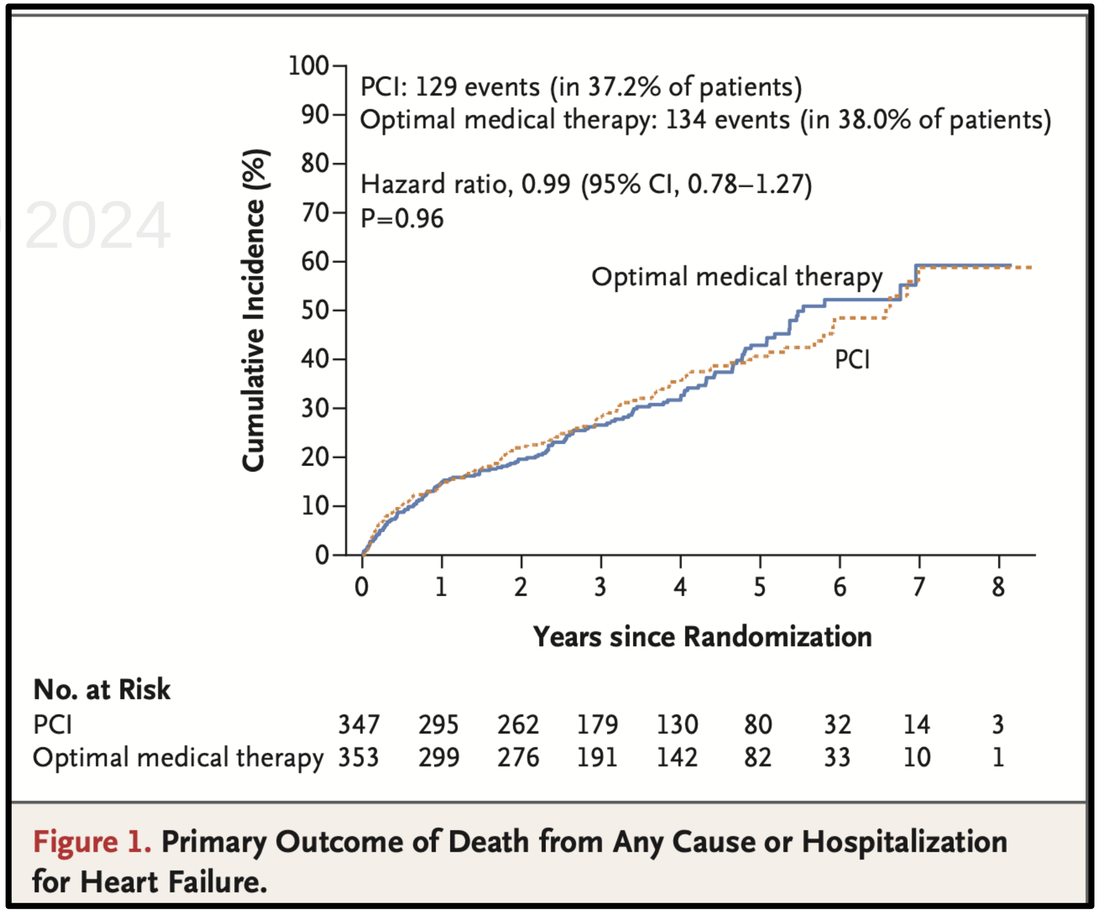


Figure 1. Primary Outcome of Death from Any Cause or Hospitalization for Heart Failure.

Survival benefit of revascularization in HF

Meta-analysis, 21 studies, 16,191 patients

1° outcome – all cause mortality

2° outcome – MI, revascularization, stroke

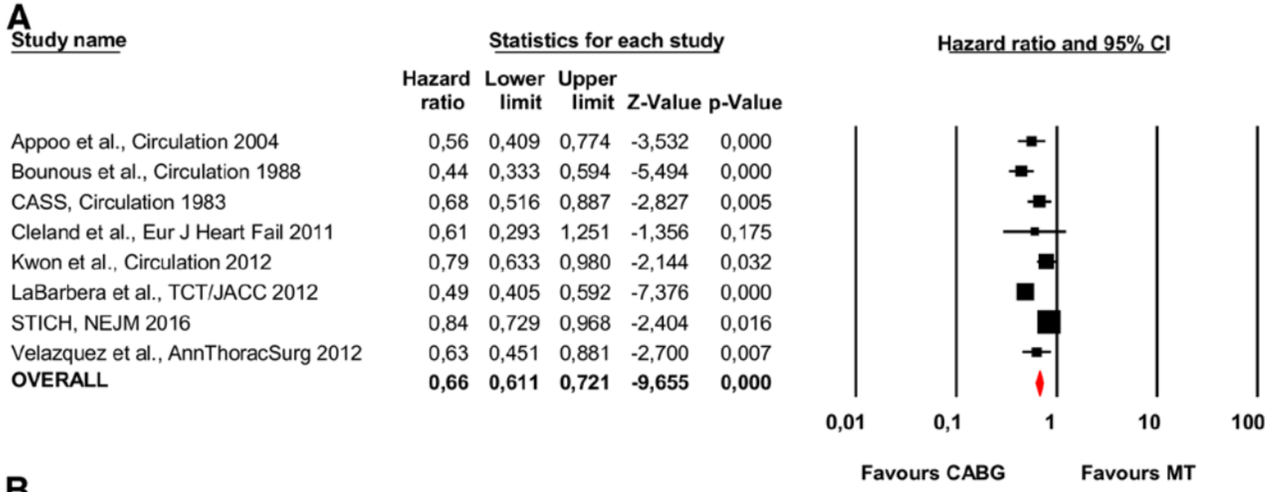
CABG vs MT, HR 0.66, p < 0.001

PCI vs MT, HR 0.73, p < 0.001

CABG vs PCI, HR 0.82, p < 0.01

Wolff, et al. Circ Heart Fail 2017 Jan 10(1)

A



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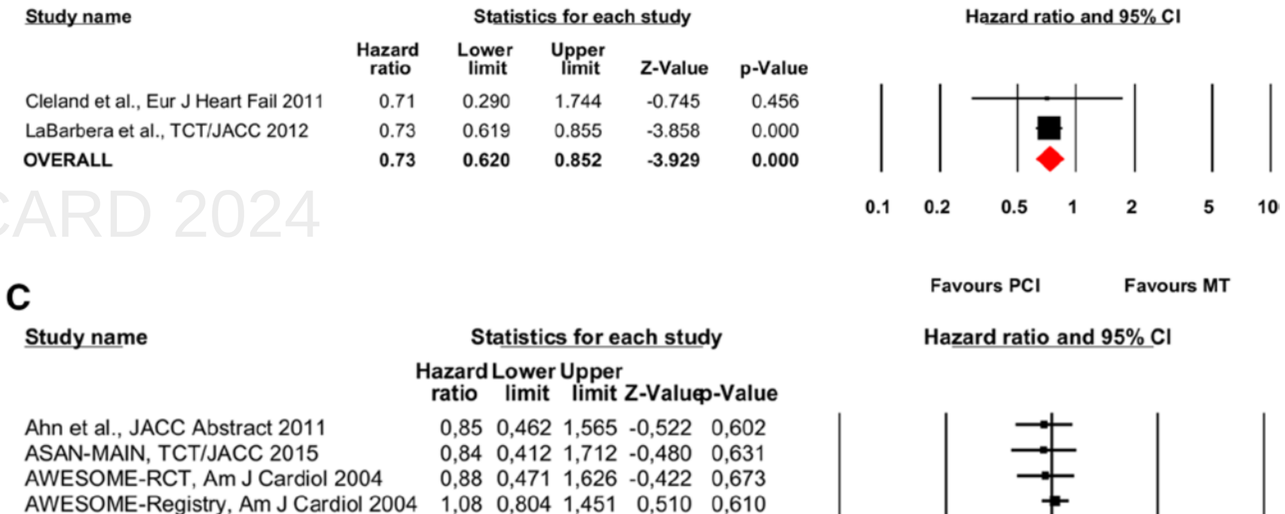

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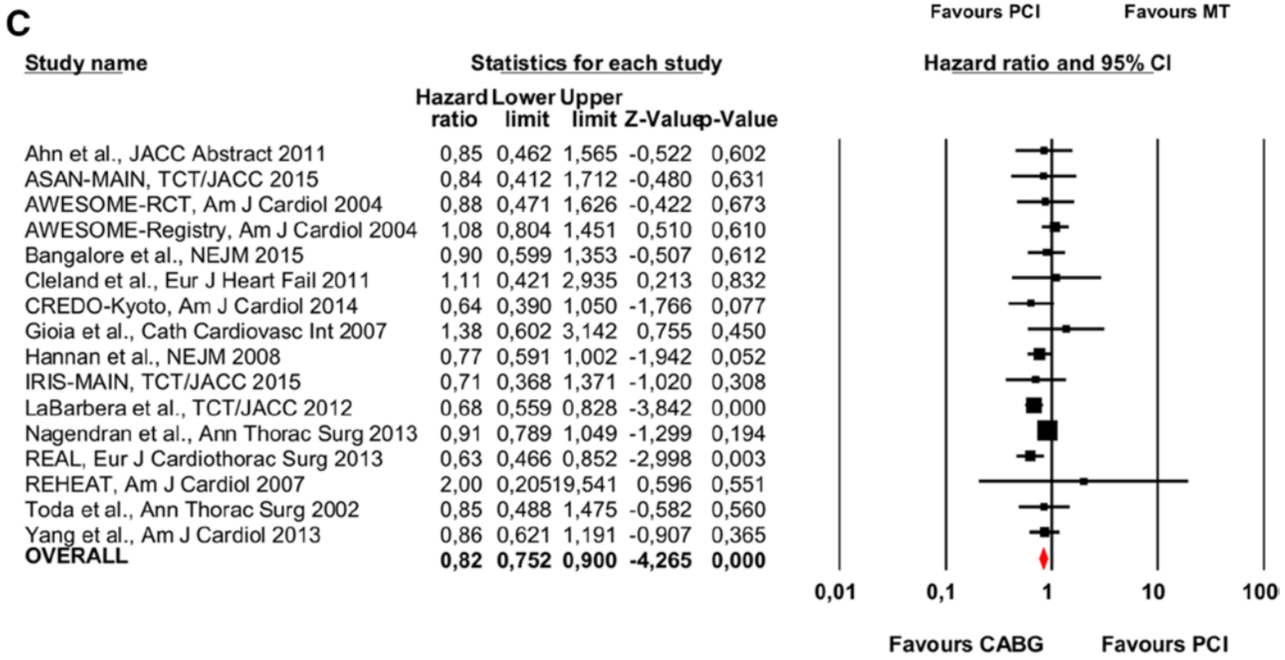
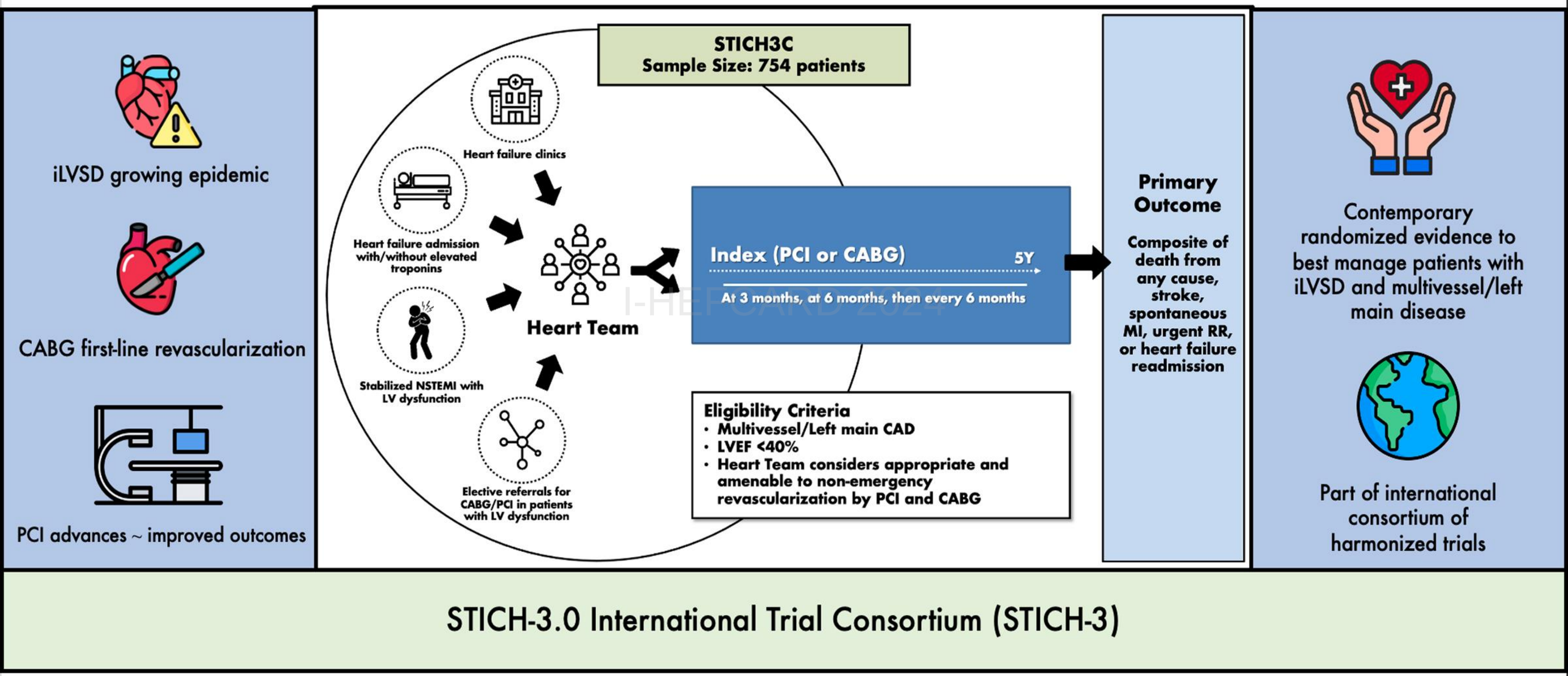


Revascularization Option in Ischemic Cardiomyopathy

CABG

PCI

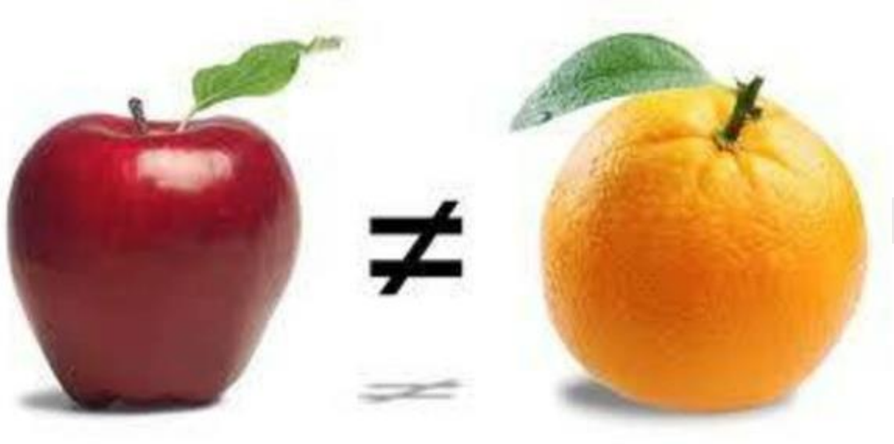
The Canadian CABG or PCI in Patients with Ischemic Cardiomyopathy Trial (STICH3C): Rationale and Study Protocol



STICH-3.0 International Trial Consortium (STICH-3)

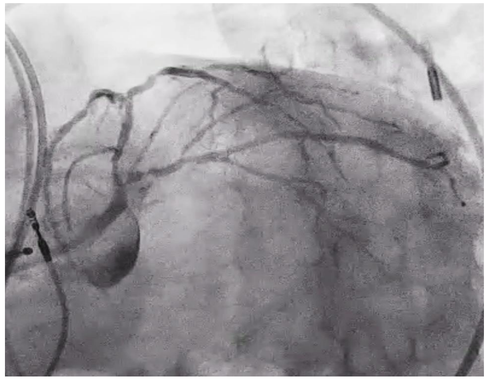
Fremes et al. *Circulation: Cardiovascular Interventions*. 2023.

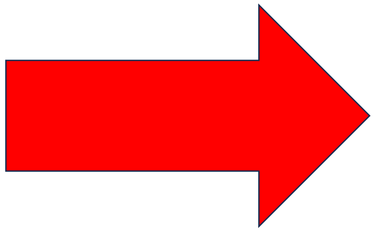
Not all ischemic cardiomyopathy is the same entity !

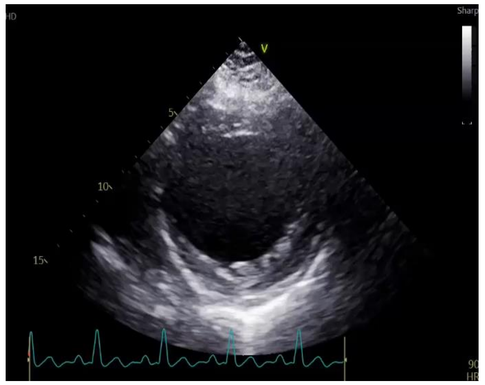


- Misclassifying of ischemic cardiomyopathy
- Various comorbidities
- Various coronaries complexity
- Various clinical setting
- Presence of microvascular dysfunction

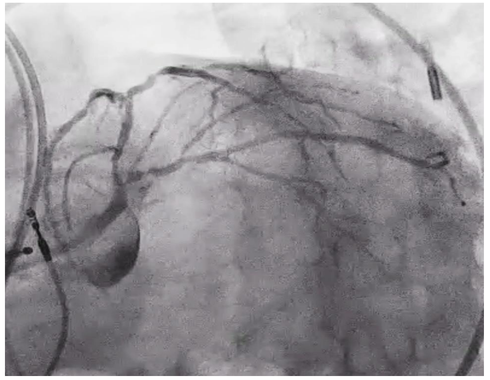
Misclassifying of Ischemic Cardiomyopathy







Ischemic Cardiomyopathy



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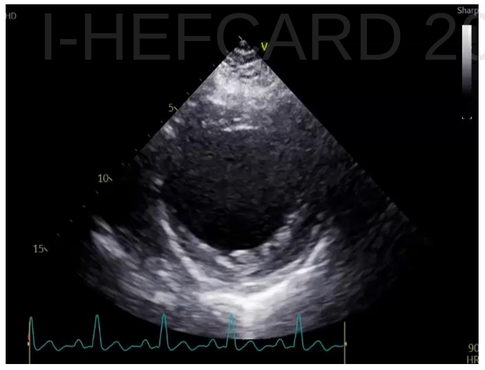
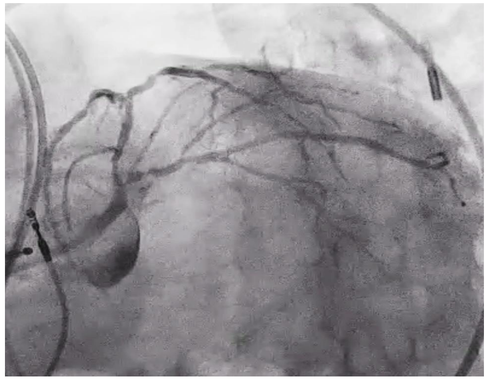


Bystander CAD and Non-Ischemic Cardiomyopathy



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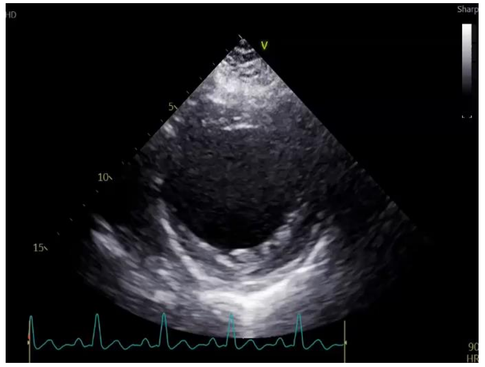
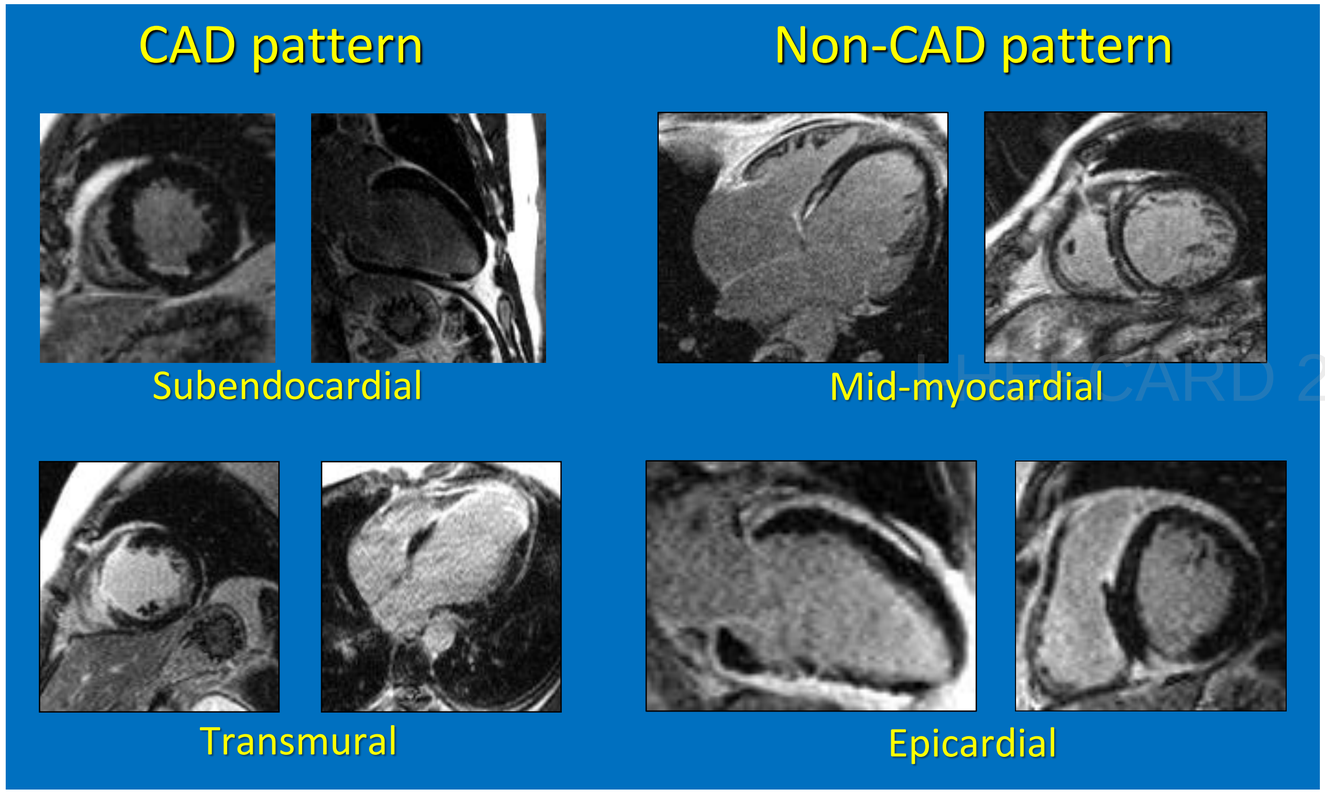
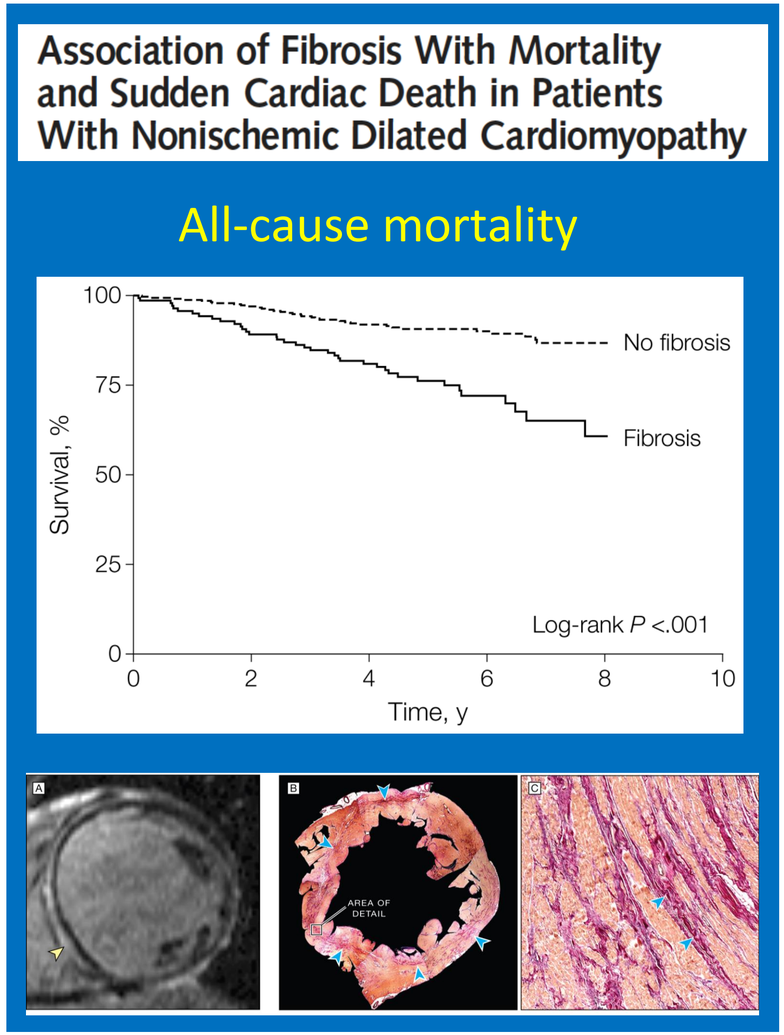


Dual Cardiomyopathy Non-Ischemic and Ischemic Cardiomyopathy

LGE in Cardiomyopathy

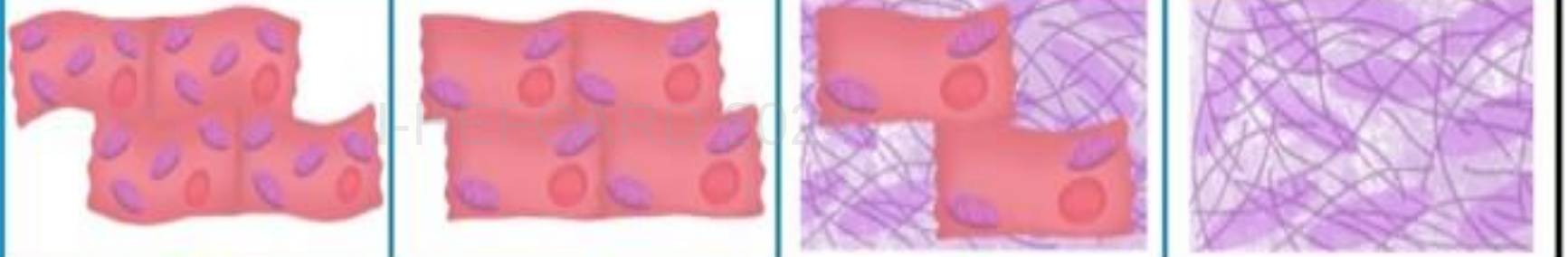




JAMA 2013; 309 (9): 896-902

Ischemic Cardiomyopathy

A continuous spectrum process

Ischaemic Left Ventricular Dysfunction				
Stages of Viability	**Stunning**	**Early Hibernation**	**Advanced Hibernation**	**Infarction**
				
Contractile Reserve	++	+	(+)	−
Glucose metabolism	+	++	++	−
Extracellular volume	(+)	(+)	+	++
Chance of recovery	100%			0%
Time to recovery	Days	Weeks	Months	N/A

European Heart Journal (2022) 43, 118–126

Mechanisms of myocardial ischemia

Epicardial coronary artery

Coronary microvessels

Atherosclerosis

Stable plaque → Reduction in CFR → Demand ischaemia ± angina

Vulnerable plaque → Plaque rupture → Thrombosis → Acute coronary syndromes/infarction

Vasospasm

Focal/transient vasospasm → Prinzmetal angina

Persistent vasospasm → Myocardial infarction

Microvascular dysfunction

Impairs coronary physiology and myocardial blood flow in subjects with risk factors

- Contributes to myocardial ischaemia in CAD and CMP
- Induces severe acute ischaemia 'Takotsubo'

Who will benefit most from revascularization ?

Coronary Anatomy

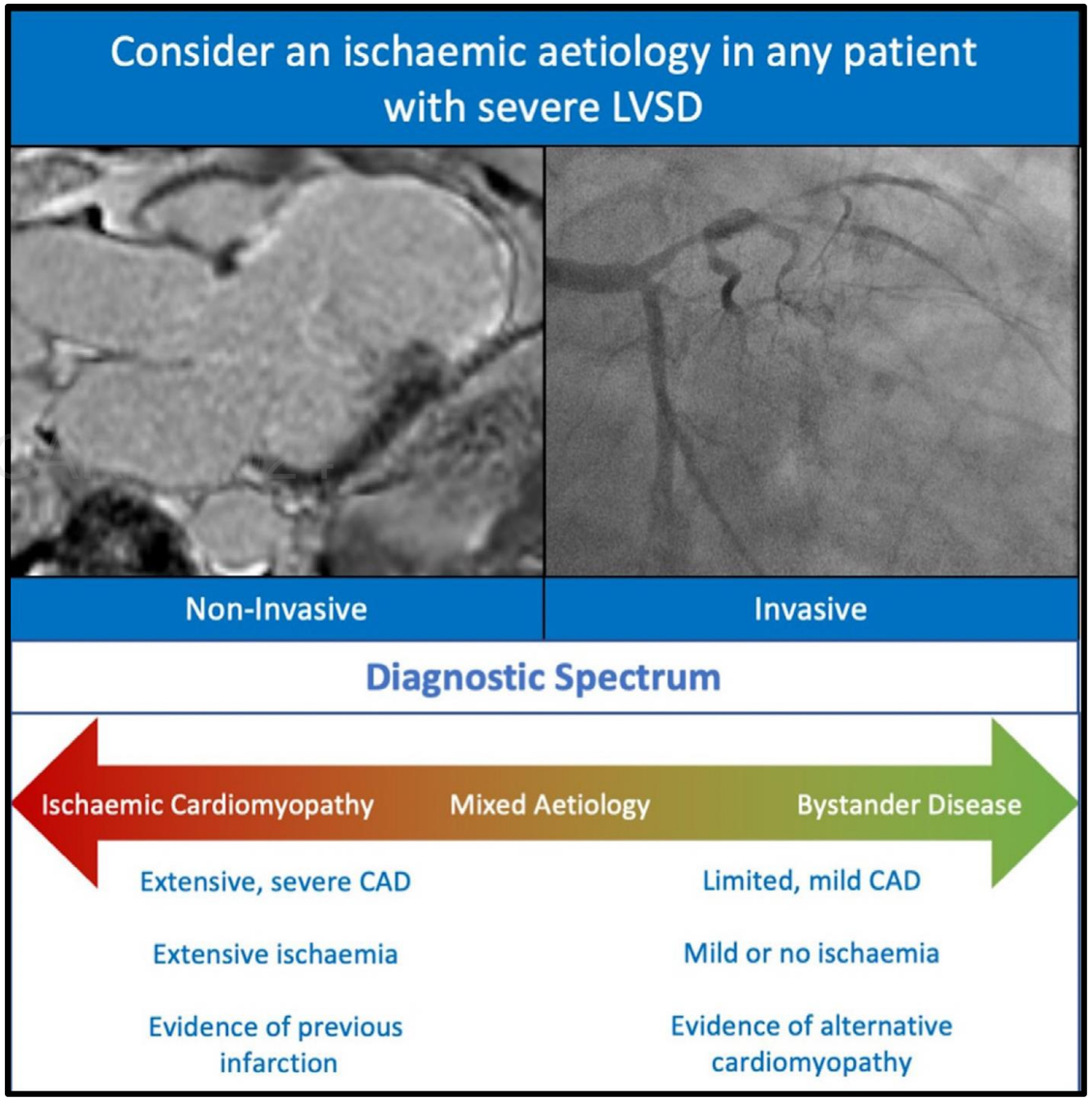
✓ Multivessel obstruction

LV Function

✓ Severely Impaired

Clinical Status

✓ Symptomatic



Heart 2021;107:612–618.

Guidelines Recommendation

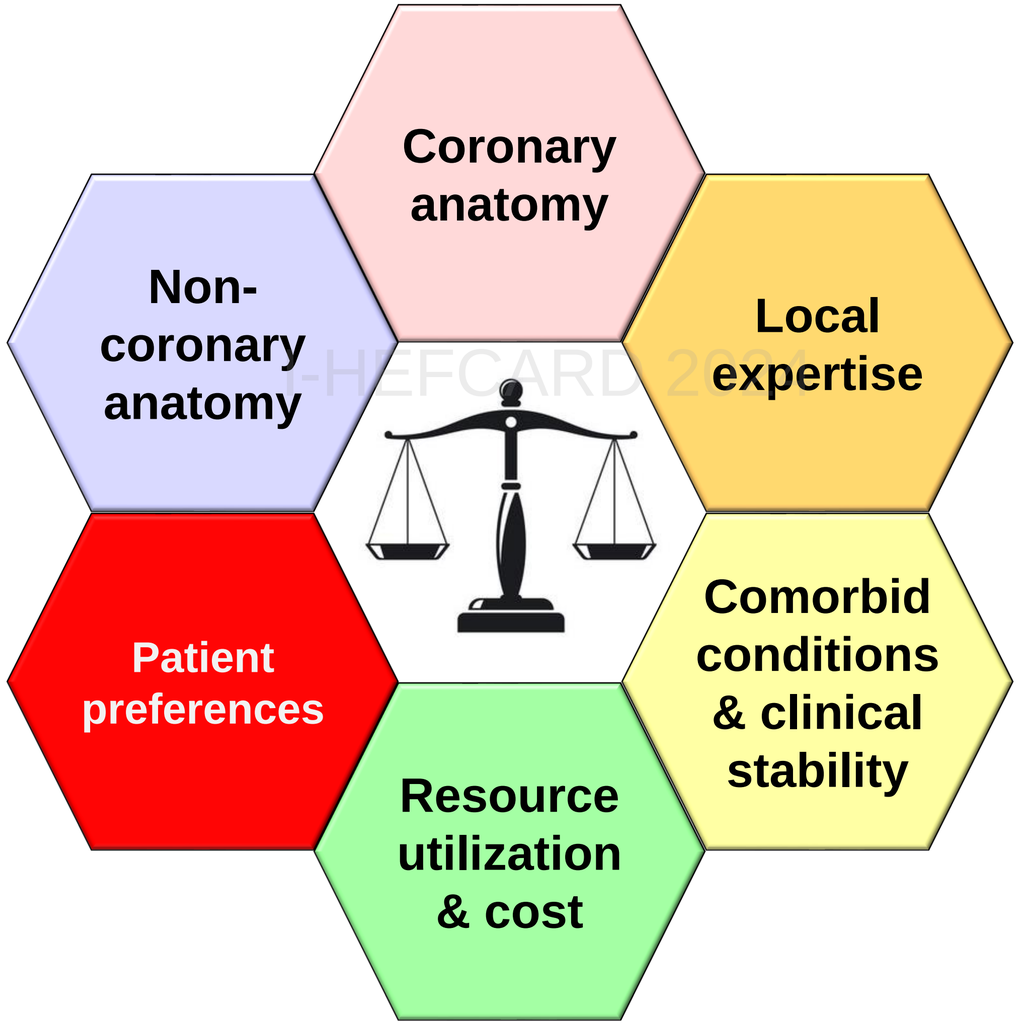
PCI in Ischemic Cardiomyopathy

Recommendations on revascularizations in patients with chronic heart failure and systolic left ventricular dysfunction (ejection fraction ≤35%)

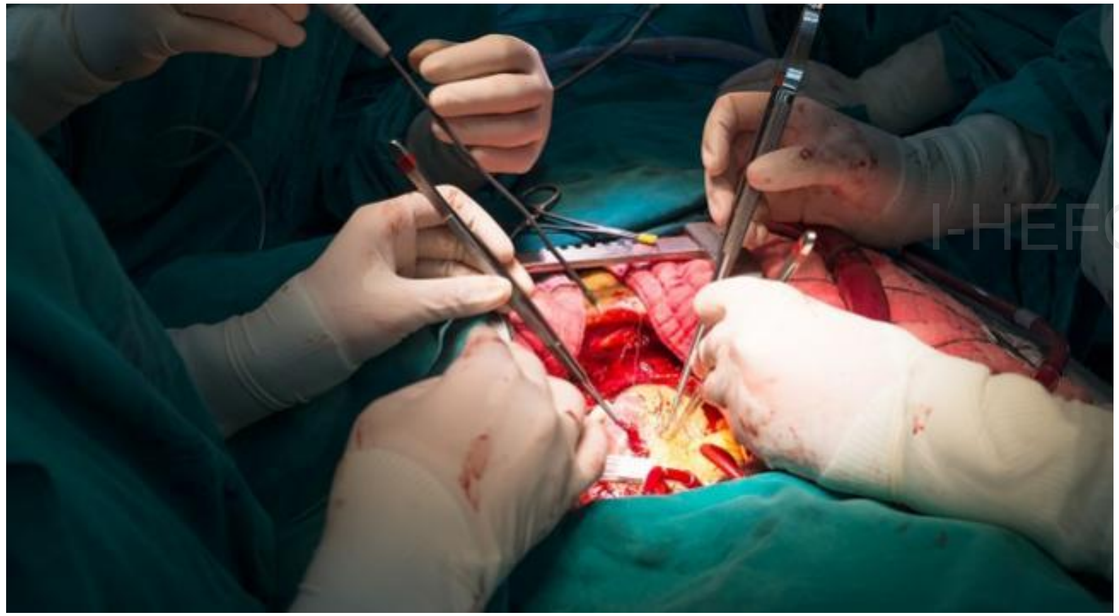
Recommendations	Class[a]	Level[b]
In patients with severe LV systolic dysfunction and coronary artery disease suitable for intervention, myocardial revascularization is recommended.[81,250]	I	B
CABG is recommended as the first revascularization strategy choice in patients with multivessel disease and acceptable surgical risk.[68,81,248,255]	I	B
In patients with one- or two-vessel disease, PCI should be considered as an alternative to CABG when complete revascularization can be achieved.	IIa	C

	Coronary artery bypass grafting (CABG)	Percutaneous coronary intervention (PCI)
European Society of Cardiology[3]	CABG is recommended as the first revascularisation strategy in patients with multivessel disease and acceptable surgical risk (I B).	PCI should be considered in one-vessel or two-vessel disease when complete revascularisation can be achieved or with three-vessel disease based on Heart Team evaluation (IIa C).
American College of Cardiology/American Heart Association[4]	Revascularisation with CABG is sometimes recommended for patients with LVEF ≤35% without significant left mainstem CAD (IIb B).	There are insufficient data to make a recommendation.

Decision Making in Revascularization for Ischemic Cardiomyopathy



Ischemic Cardiomyopathy : Candidate for CABG?



- Younger patient (<60 yo)
- High SYNTAX score
- Anterior wall viability
- Few comorbidities
- Need for valve surgery

If patient said yes !!!

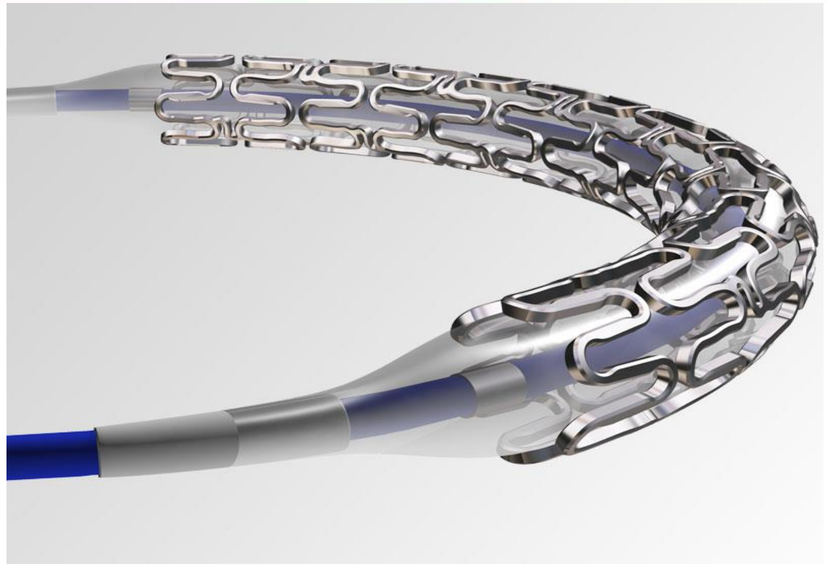
Major Adverse Events Within 30 Days

	PCI (n=948)	CABG (n=957)	RR [95%CI]	P-value
Peri-procedural MAE, any	12.4%	44.0%	0.28 [0.24, 0.34]	<0.001
- Death*	0.9%	1.0%	0.91 [0.39, 2.23]	0.83
- Stroke*	0.6%	1.3%	0.50 [0.19, 1.34]	0.16
- Myocardial infarction*	3.9%	6.2%	0.63 [0.42, 0.95]	0.02
- Ischemia-driven revascularization*	0.6%	1.4%	0.47 [0.18, 1.22]	0.11
- TIMI major/minor bleeding	3.7%	8.9%	0.42 [0.28, 0.61]	<0.001
- Transfusion ≥2 units	4.0%	17.0%	0.24 [0.17, 0.33]	<0.001
- Major arrhythmia**	2.1%	16.1%	0.13 [0.08, 0.21]	<0.001
- Surgery/radiologic procedure	1.3%	4.1%	0.31 [0.16, 0.59]	<0.001
- Renal failure†	0.6%	2.5%	0.25 [0.10, 0.61]	<0.001
- Sternal wound dehiscence	0.0%	2.0%	0.03 [0.00, 0.43]	<0.001
- Infection requiring antibiotics	2.5%	13.6%	0.18 [0.12, 0.28]	<0.001
- Prolonged intubation (>48 hours)	0.4%	2.9%	0.14 [0.05, 0.41]	<0.001
- Post-pericardiotomy syndrome	0.0%	0.4%	0.11 [0.01, 2.08]	0.12

*Adjudicated events; others are site-reported. **SVT requiring cardioversion, VT or VF requiring treatment, or bradyarrhythmia requiring temp or perm PM. †SCr increased by ≥0.5 mg/dL from baseline or need for dialysis.

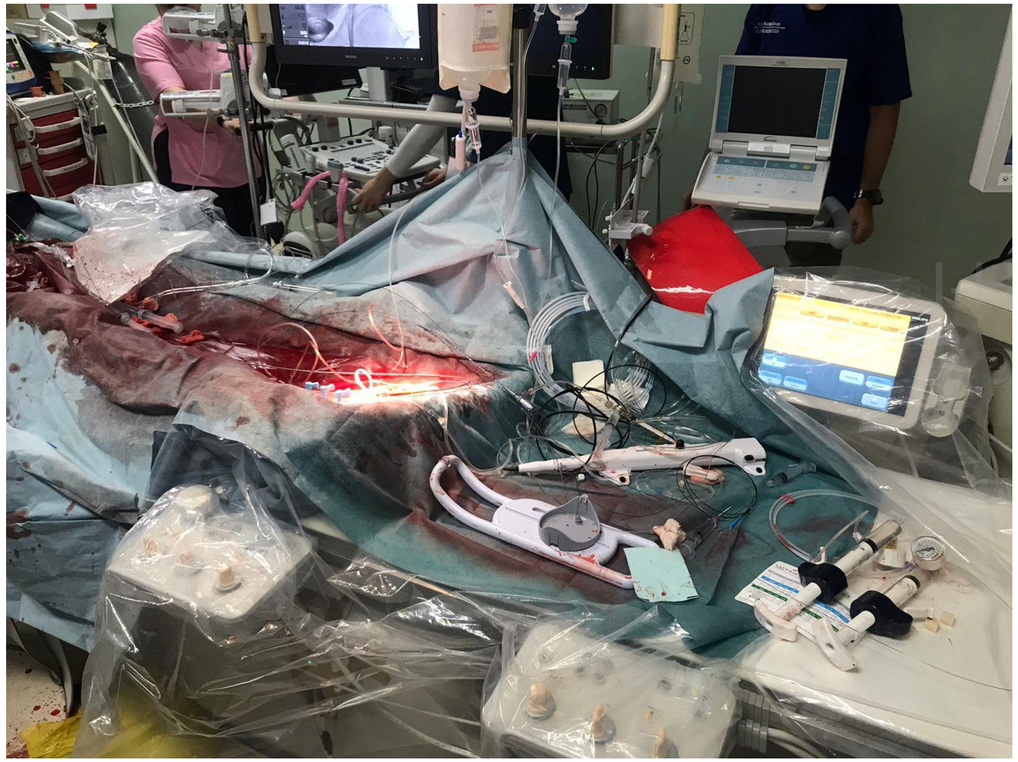
Stone GW et al. N Engl J Med 2016;375:2223-35

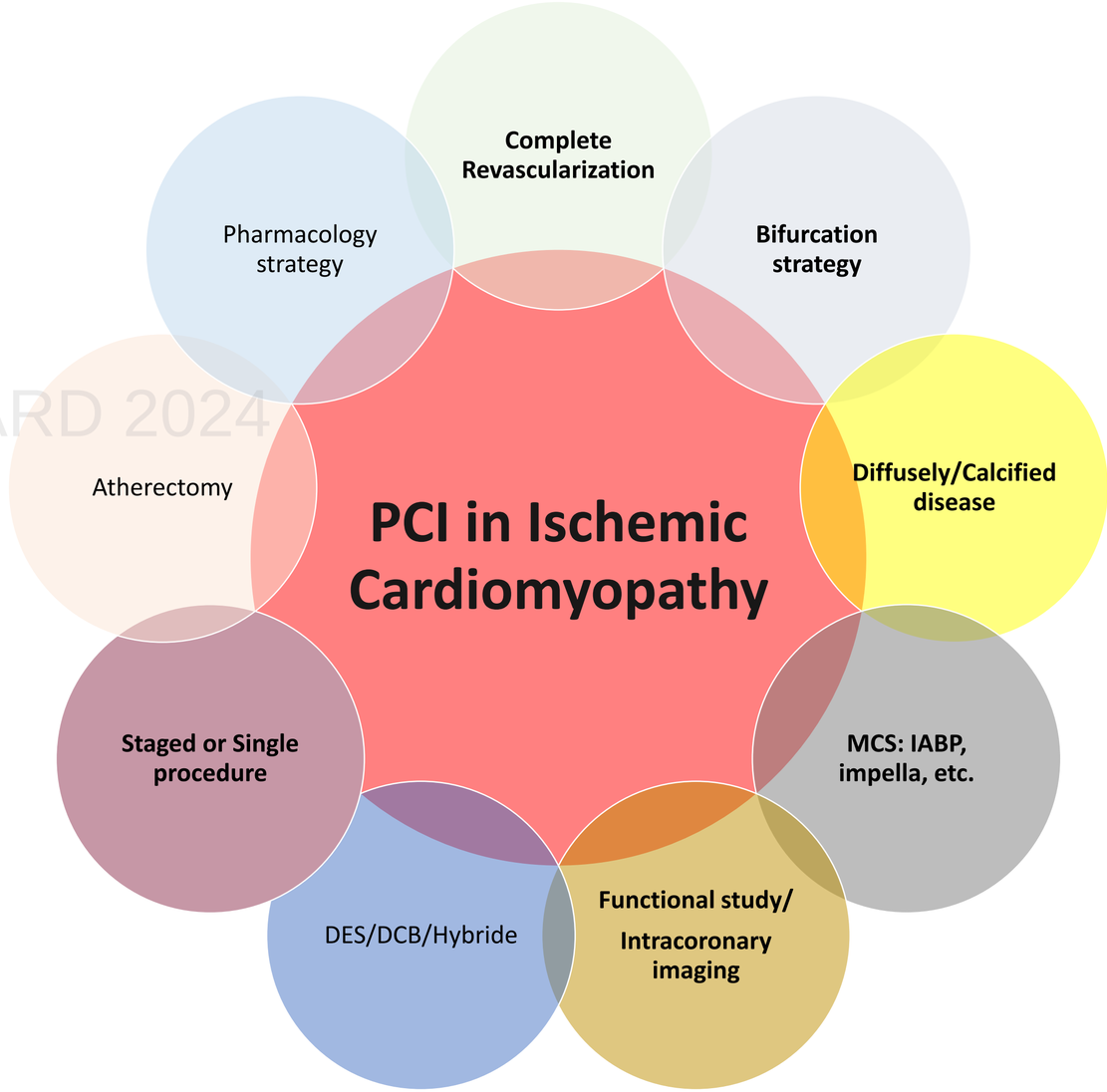
Ischemic Cardiomyopathy : Candidate for PCI



- Comorbidities and Surgical inabilities
- Previous CABG
- Target vessel supply viable myocardium
- Trained complex PCI operator and team

PCI in Ischemic Cardiomyopathy



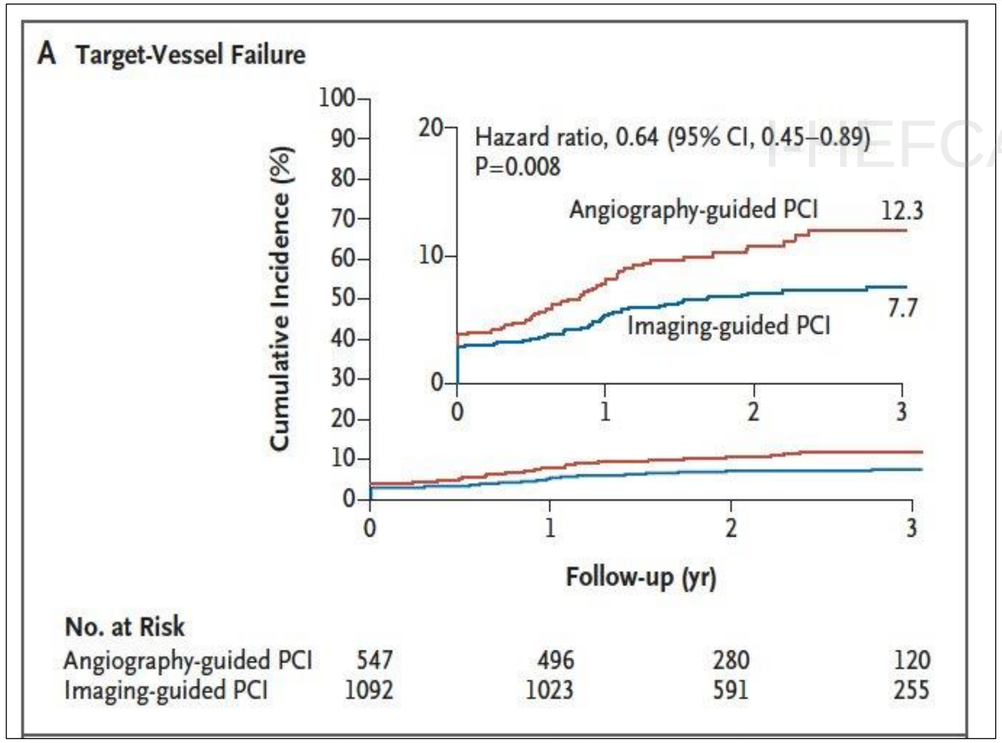


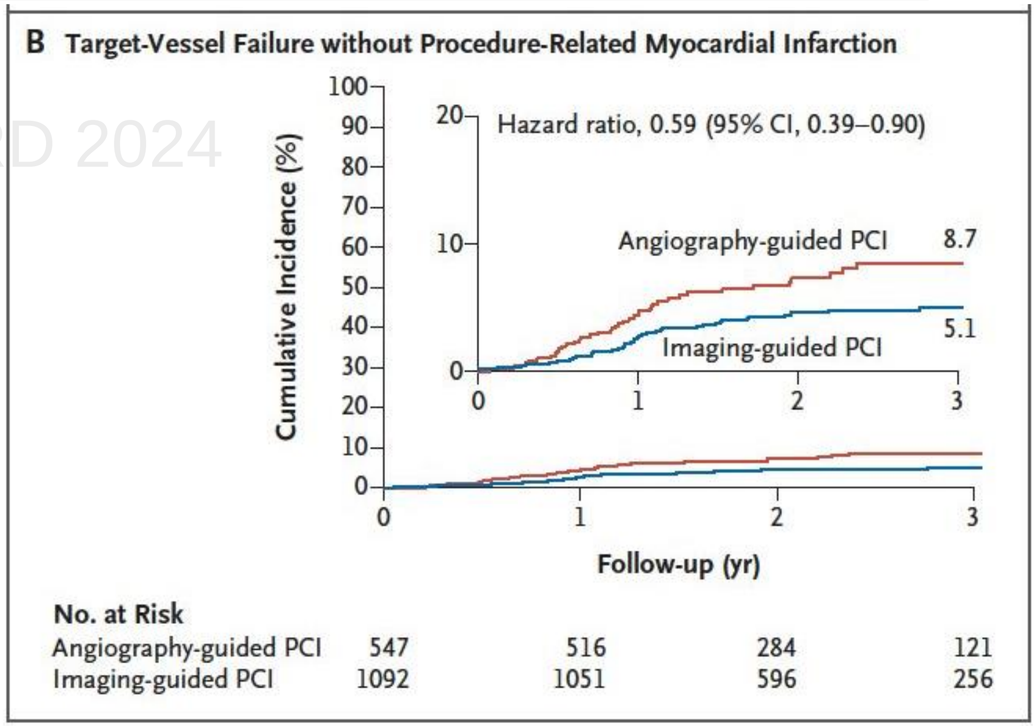
ORIGINAL ARTICLE FREE PREVIEW

Intravascular Imaging–Guided or Angiography-Guided Complex PCI

Joo Myung Lee, M.D., Ph.D., M.P.H., Ki Hong Choi, M.D., Ph.D., Young Bin Song, M.D., Ph.D., Jong-Young Lee, M.D., Ph.D., Seung-Jae Lee, M.D., Ph.D., Sang Yeub Lee, M.D., Ph.D., Sang Min Kim, M.D., Ph.D., Kyeong Ho Yun, M.D., Ph.D., Jae Young Cho, M.D., Ph.D., Chan Joon Kim, M.D., Ph.D., Hyo-Suk Ahn, M.D., Ph.D., Chang-Wook Nam, M.D., Ph.D., et al., for the RENOVATE-COMPLEX-PCI Investigators*

Imaging-guided PCI was more effective than angiography guided PCI, especially in complex PCI



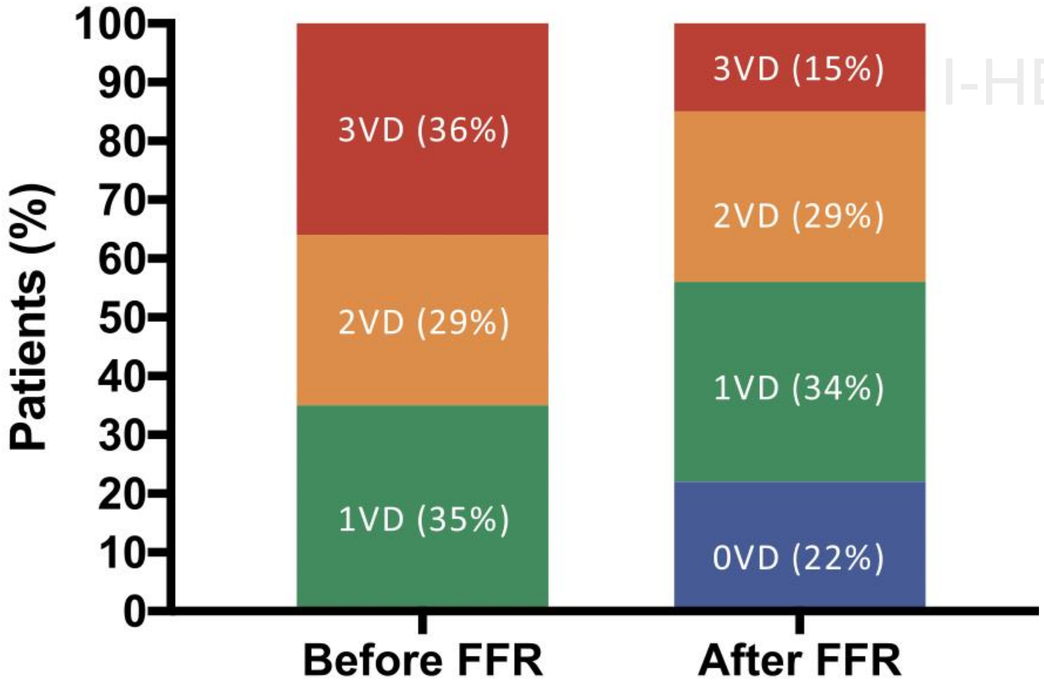


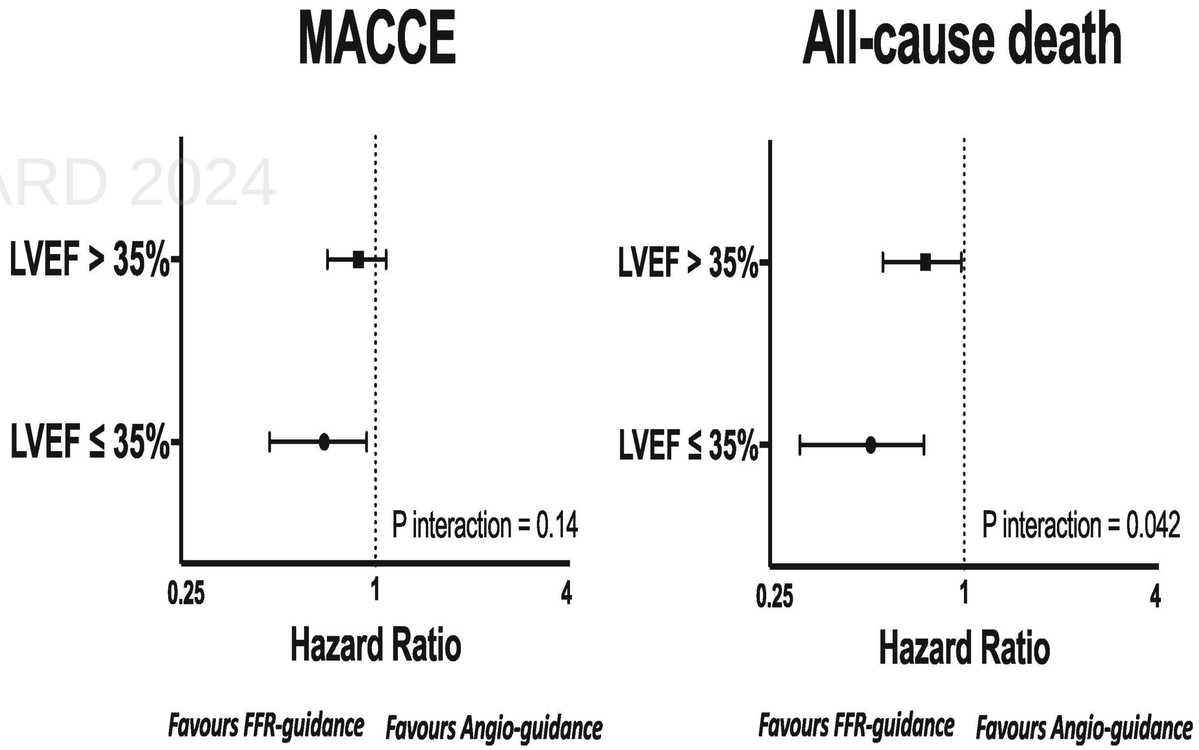
N Engl J Med 2023; 388:1668-1679

Fractional Flow Reserve in Patients with Reduced Ejection Fraction

Cohort study, propensity matched
FFR-guided (433 pt) vs Angio-guided (866 pts), baseline LVEF <40%

Downgrading in the number of diseased vessels after FFR measurement

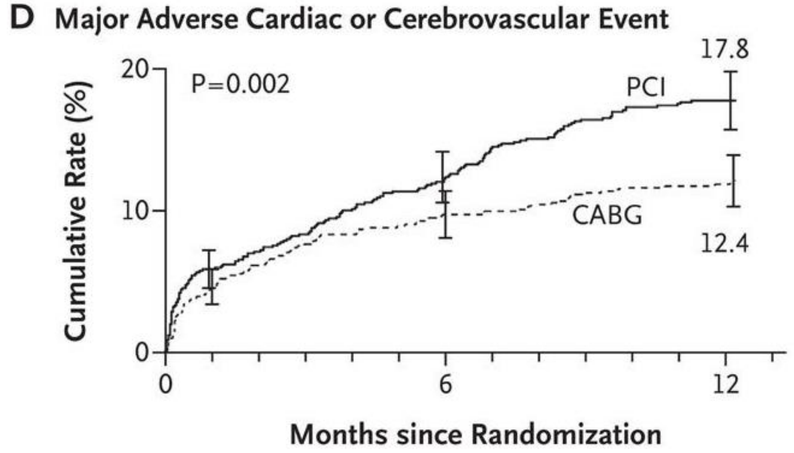




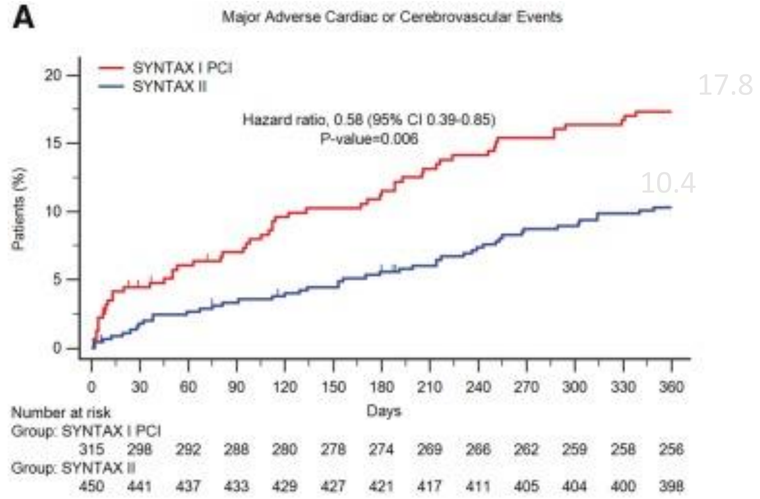
Eur Heart J. 2020 May 1;41(17):1665-1672.

How to Improve PCI Outcomes in Ischemic cardiomyopathy

SYNTAX 1



SYNTAX 2



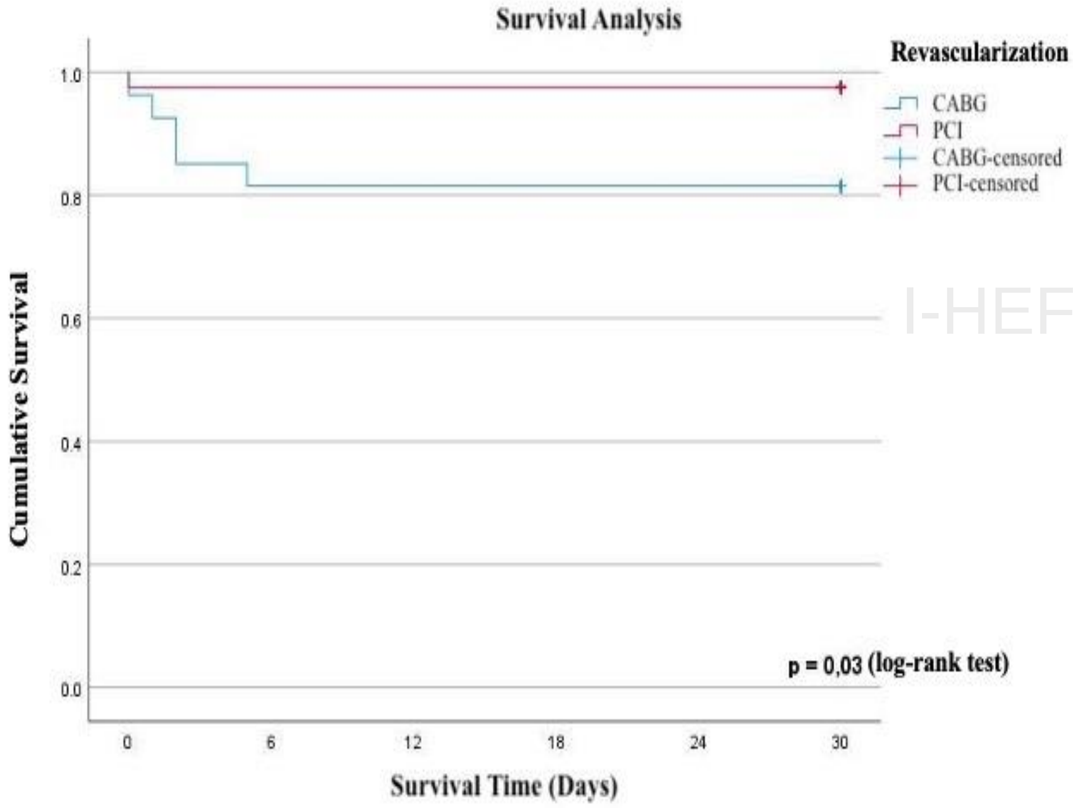
- Patient selection
  - Objective assessment of rational for revascularization
  - Functional lesion assessment
  - Hemodynamic assessment
  - Co-morbidity assessment and management

- Technical considerations
  - Functionally complete revasc
  - LMCA/CTO expertise
  - Lesion preparation
  - Stent optimization
  - Contemporary stents/DAPT
  - Hemodynamic support

Revascularization Outcome of Ischemic CM: CABG vs PCI
Dr Hasan Sadikin Hospital Registry (2021-2022, unpublished)

67 Patients Aged ≥ 18 years with Ischemic CMP, SYNTAX I Score > 22

CABG (n= 27) | PCI (n = 40)



Study Findings:

1. In 30-day follow up:
   - 5/27 patients undergone CABG died (Survival Rate 81.5%)
   - 1/40 patients undergone PCI died (Survival Rate 97.5%)
2. Mostly PCI was done with intracoronary imaging and DES
3. OMT only achieved in minority patients of both group (CABG vs PCI = 18.5% vs 20%, p = 0.98)
4. **30-day survival in PCI was better than CABG (p = 0.03)**
5. After multivariate analysis, similar 30-day mortality rate (adjusted HR 4.02 for CABG, 95% CI 0.27 – 60.3; p = 0.31)

Case 1

- Male, 78 yo
- Referred by HF division
- Cor Angio ; LM-3VD
- History of PPM DDDR (2012), HBP (2021)
- LVEF 20% → after OMT 31%
- Nuclear scan: reversible ischemia and viable at all LV segments
- Lab: Cr 1.98 mg/dL, eGFR 31 mL/min/1.73 m^2

But……is he really a suitable candidate for CABG ?

78 yo

- SYNTAX SCORE I: **40**
- SYNTAX SCORE II
  - **CABG 49.9**
  - **PCI: 53**
- Euroscore II: **6.34 %**
- STS Risk of mortality **8.4%**
- Frailty score: FI (Frail index): **0.47**

STS Adult Cardiac Surgery Database Version 4.20

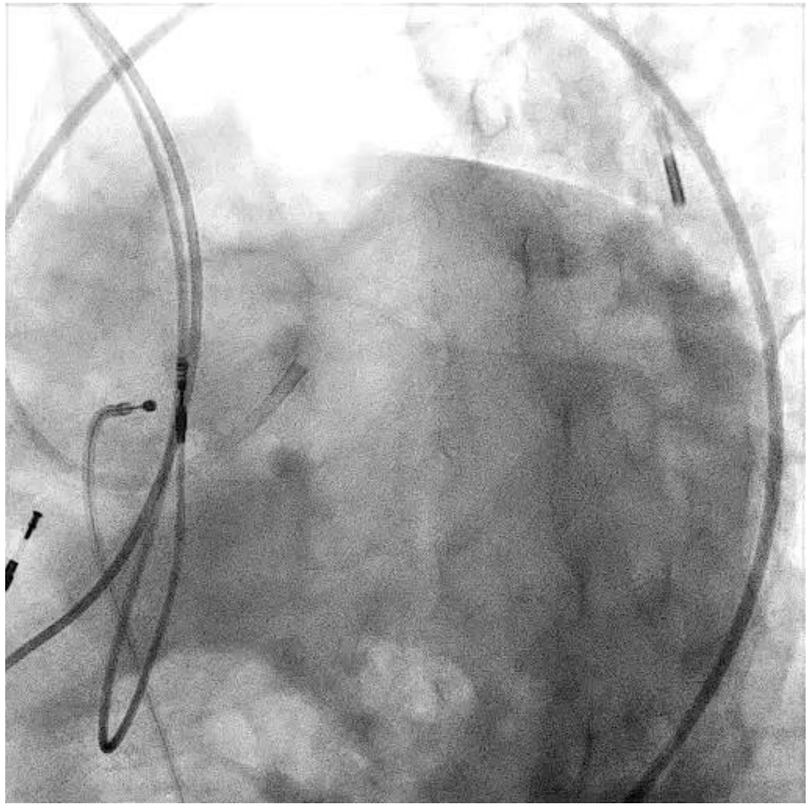
RISK SCORES

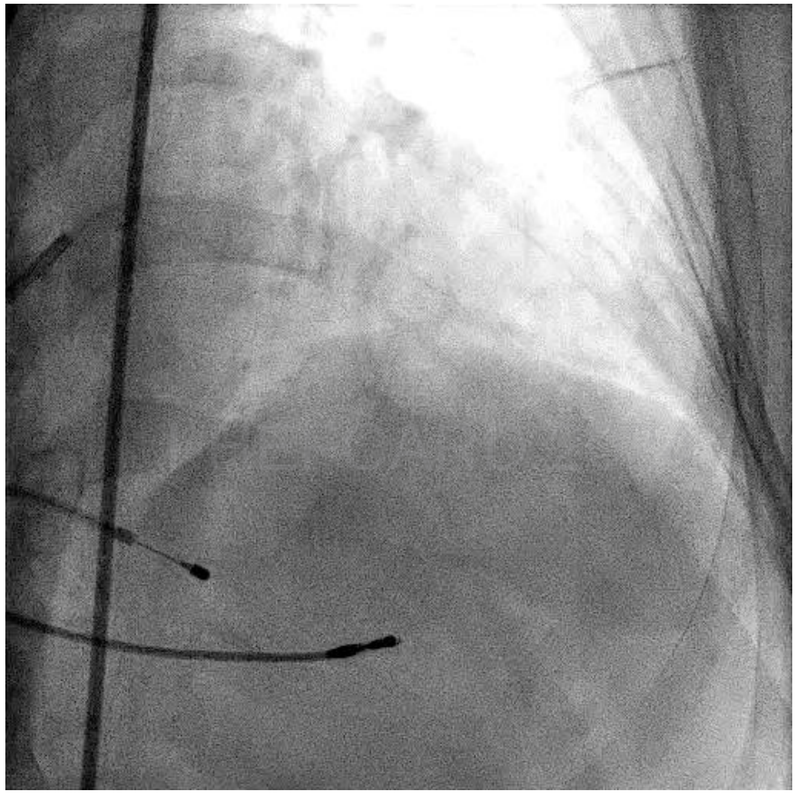
Procedure: Isolated CAB

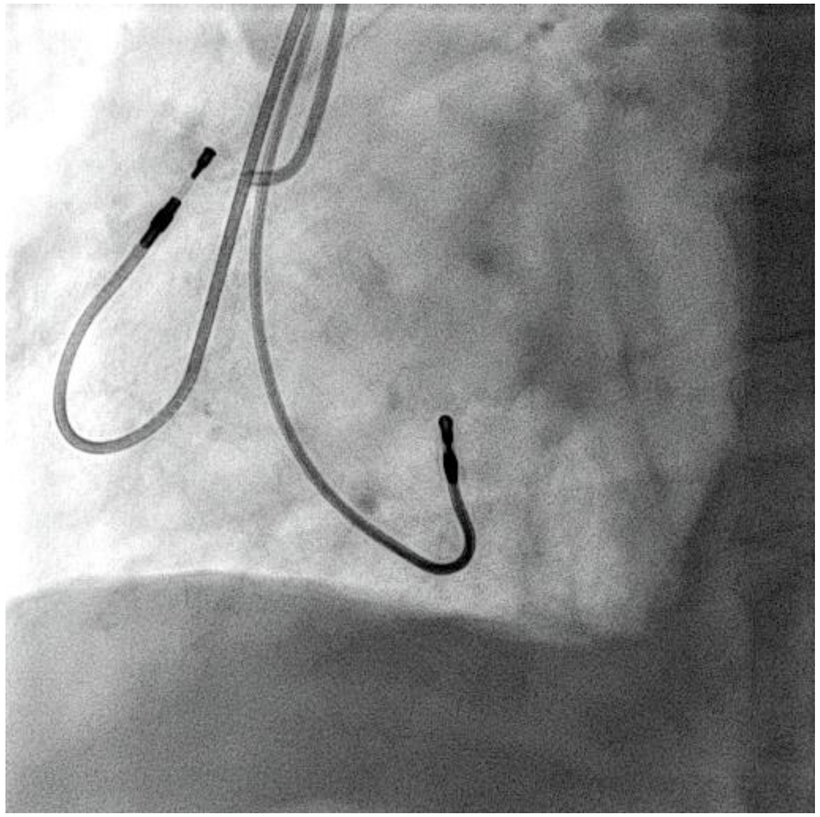
CALCULATE

Risk of Mortality:	8.477%
Renal Failure:	10.924%
Permanent Stroke:	2.222%
Prolonged Ventilation:	20.503%
DSW Infection:	0.192%
Reoperation:	8.029%
Morbidity or Mortality:	36.604%
Short Length of Stay:	11.747%
Long Length of Stay:	25.193%

Left Main Triple vessel Disease





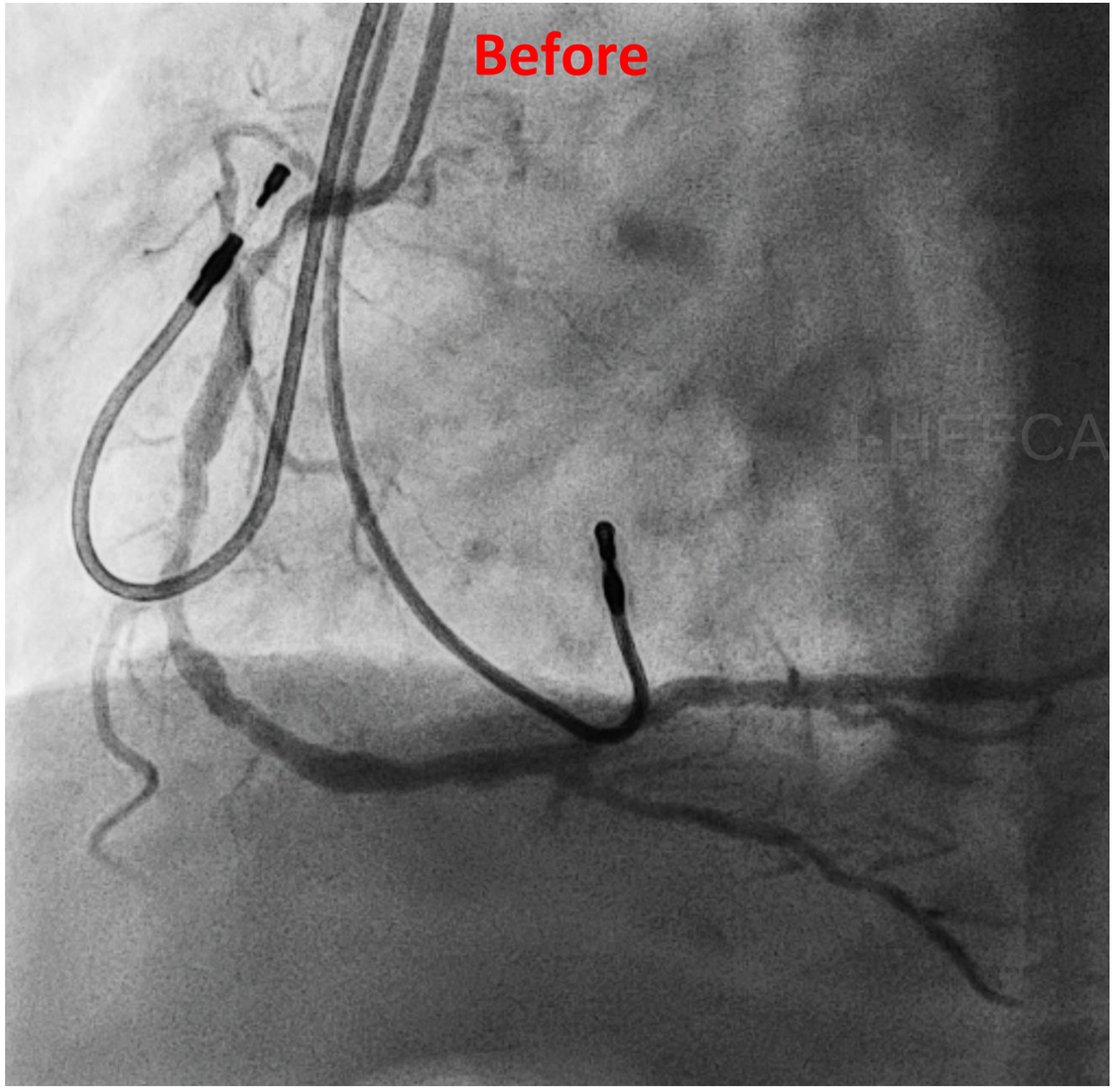


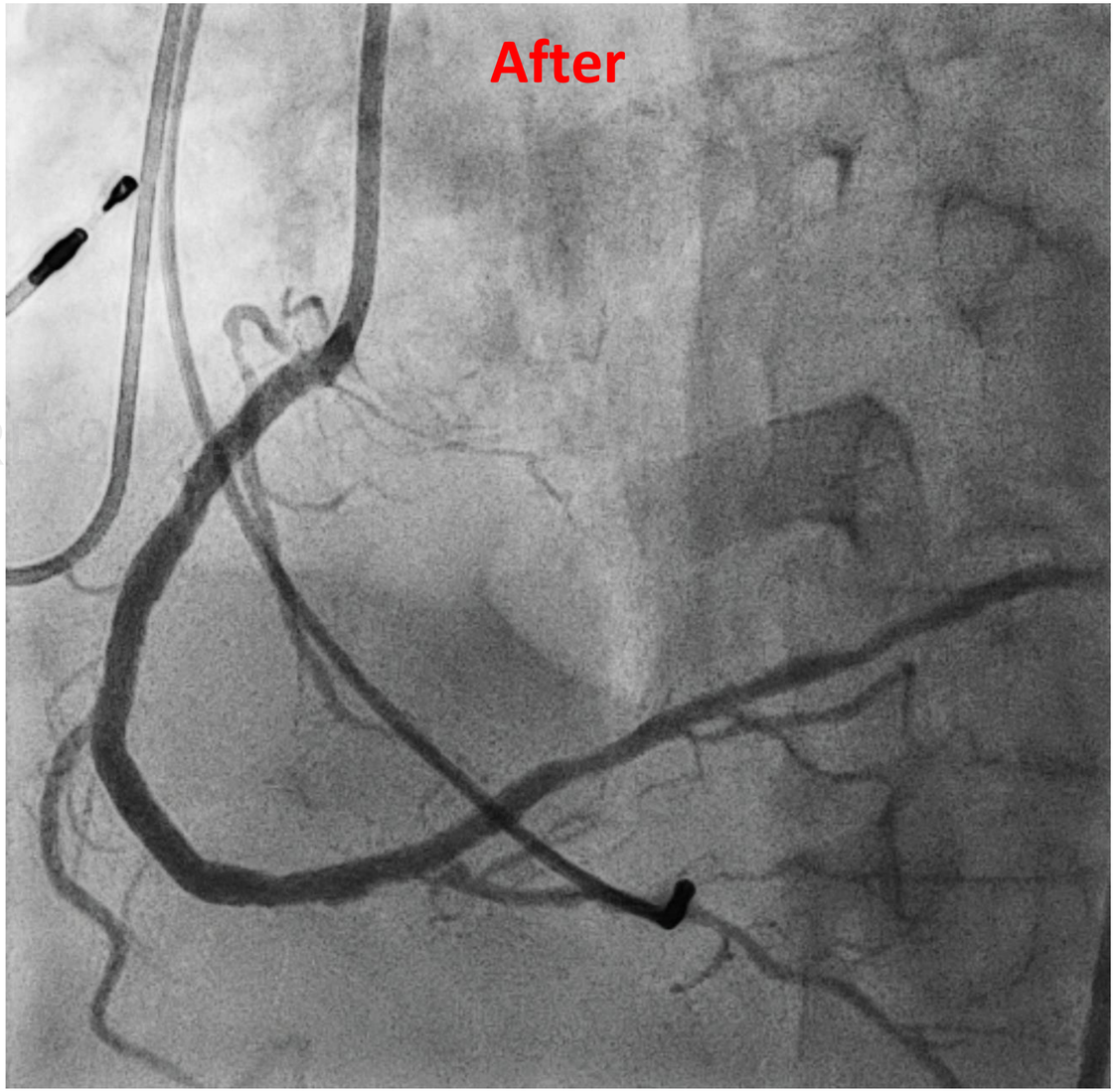
PCI strategy

- Complete revascularization
- MCS: IABP
- IVUS guided PCI (staged)

RCA: Spot stenting 3 DES

Xience Xpedition 3.5/15mm, Resolute Integrity 3.0/34mm, Ultimaster 2.75/24mm



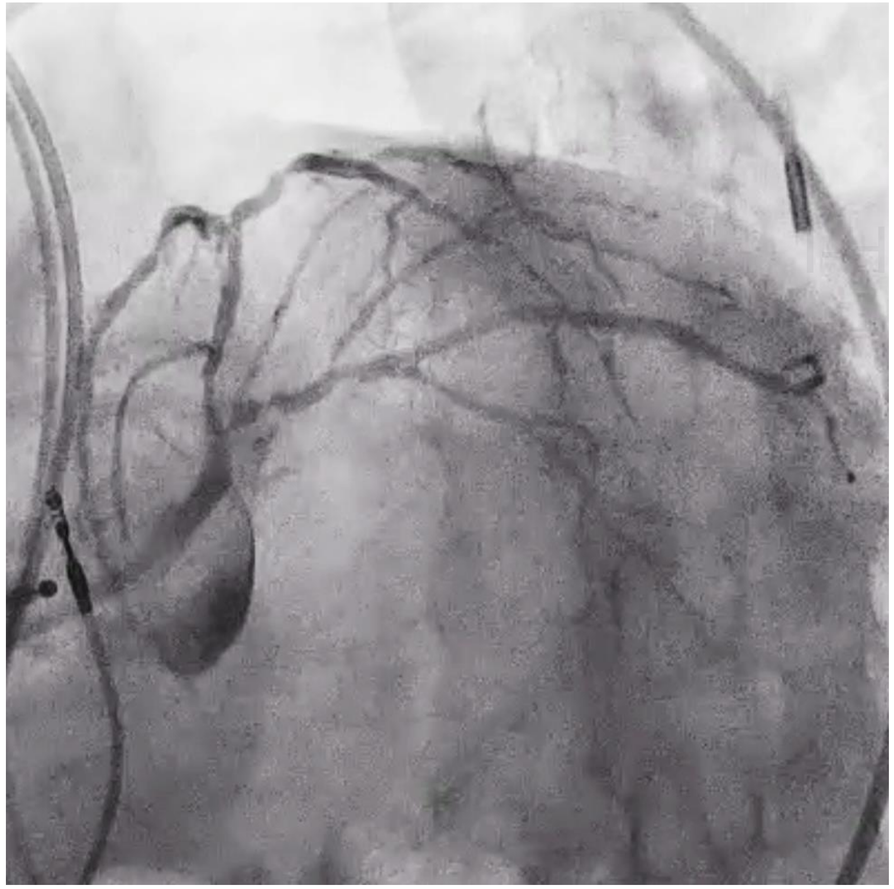


LM bifurcation: DK Culotte Stenting

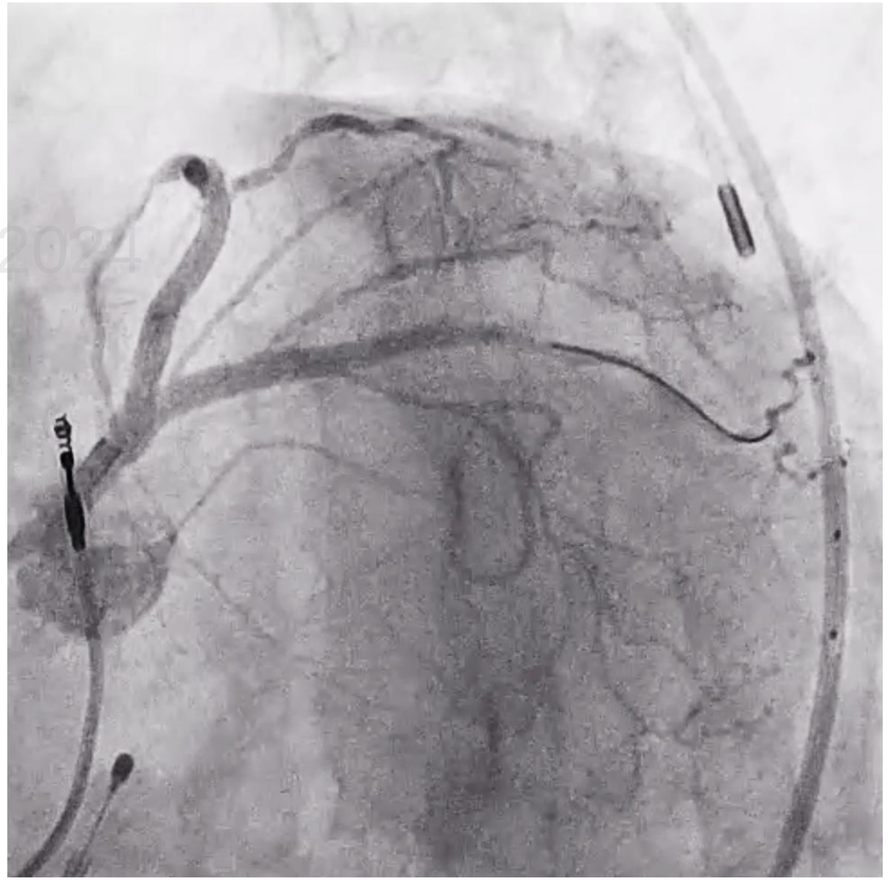
LM-LAD: 2 DES (Xience Xpedition LL 3.0/38 mm&2.5/38mm)

LM-LCx: 1 DES (Resolute Integrity 3.5/38mm) & 1 DCB (Sequent Please Neo 2.75/30mm)

Before PCI



After PCI



Case 2

Male, 54 yo,

- ***Ischemic Cardiomyopathy***
- ***CVRF : Dyslipidemia***
- ***Echo: LVEF 29%, RWMA (+)***
- ***CMRI :*** Subendocardial LGE at mid-apico lateral (transmural 100%) and mid anterior (transmural 50%)

Left coronary angiogram

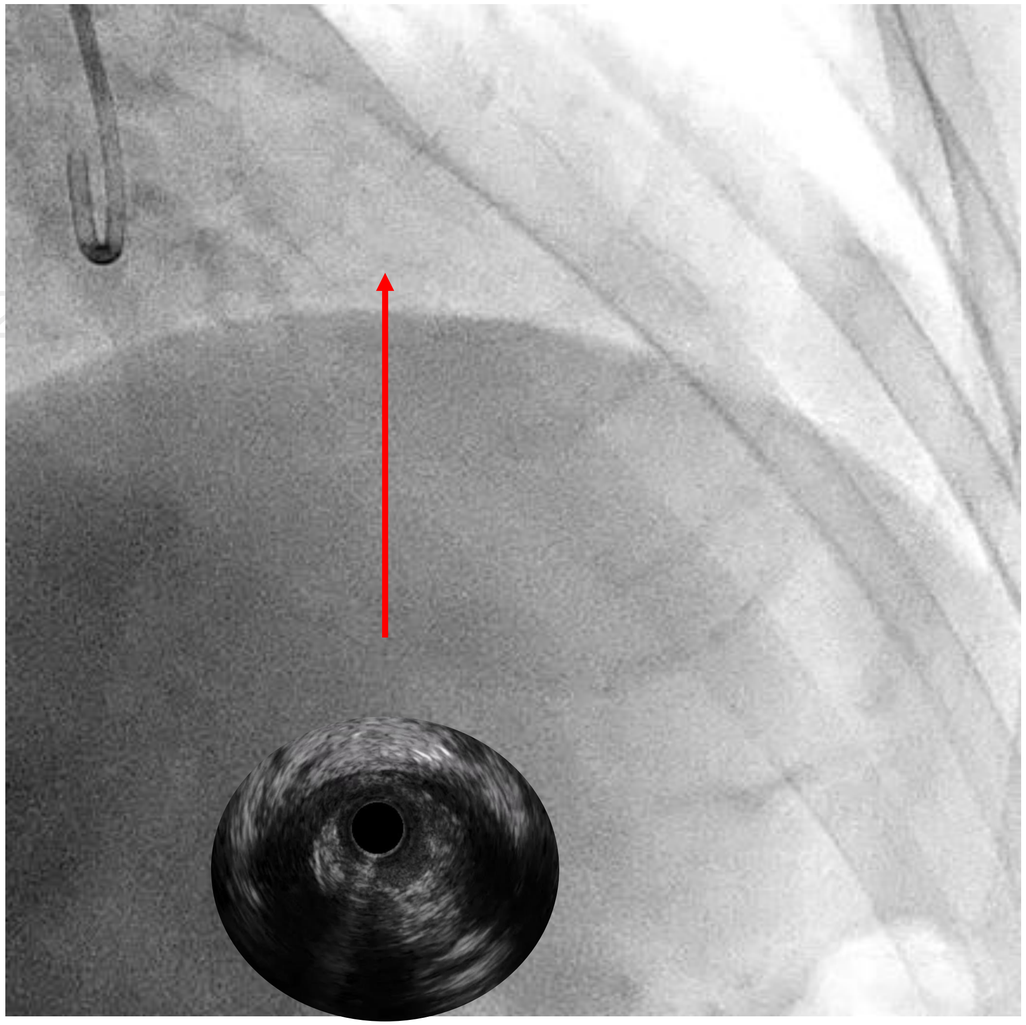
RCA: nonsignificant stenosis

Syntax score 21, Euroscore 1.7%

oLAD

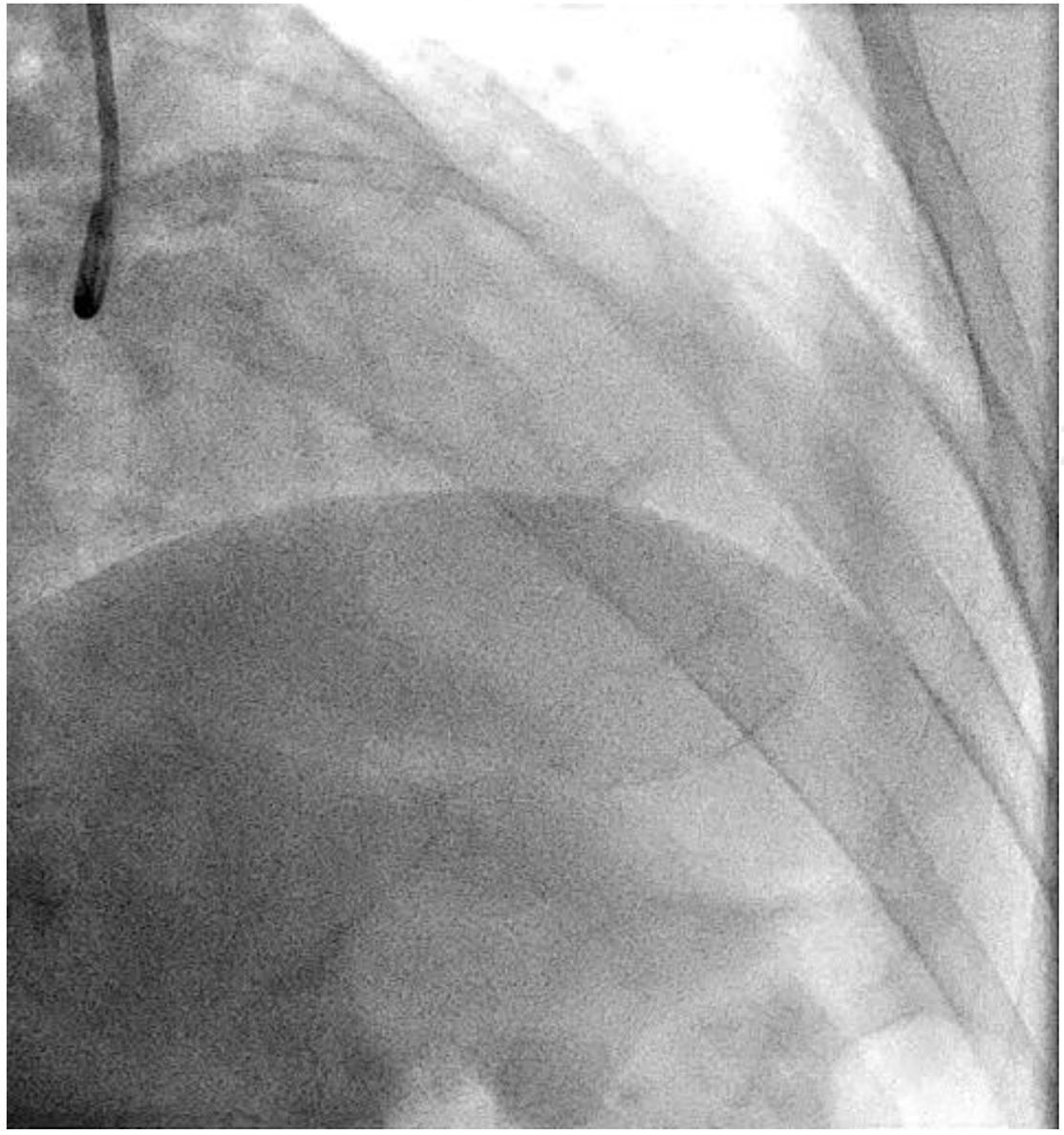
pLAD

oLCX

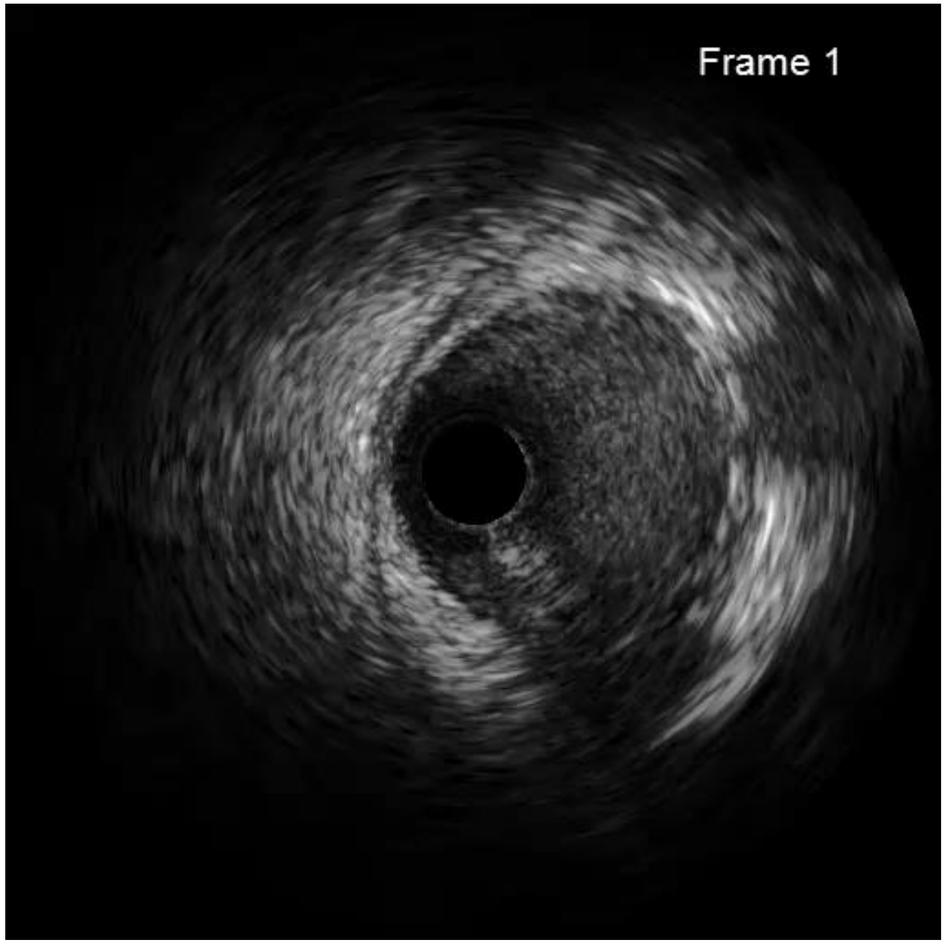


mLAD

Cross over stenting LM-LAD
2 DES (3.5x24 mm and 4.0x20 mm)



Minimal jailed strut at ostial LCx,
Optimal expansion and apposition: MSA distal LAD 7mm2, prox LAD 9 mm2, ostial LAD 10 mm2, LM 12.9 mm2



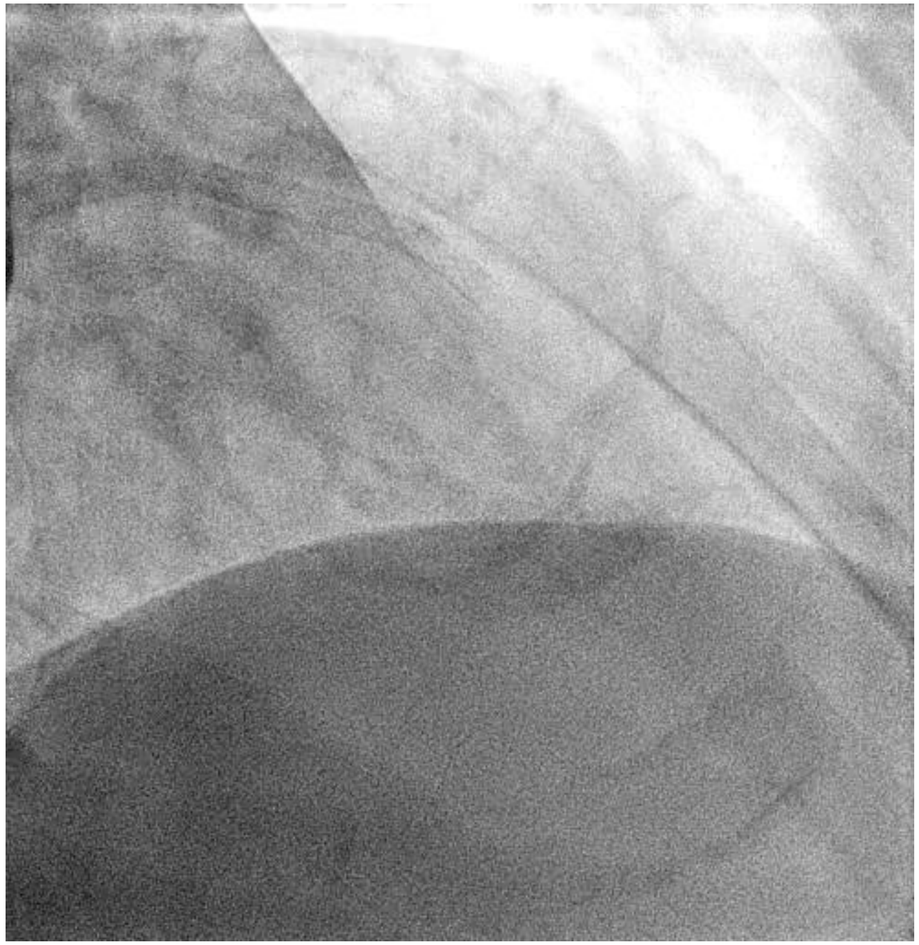
Two years follow up

Case 1

Echo: LVEF 29% → 43%

CMRI after PCI:

- Subendocardial enhancement (transmurality <25%) at mid-distal LAD
- Mid wall enhancement at lateral wall
- Impression: Dual cardiomyopathy



Case 3

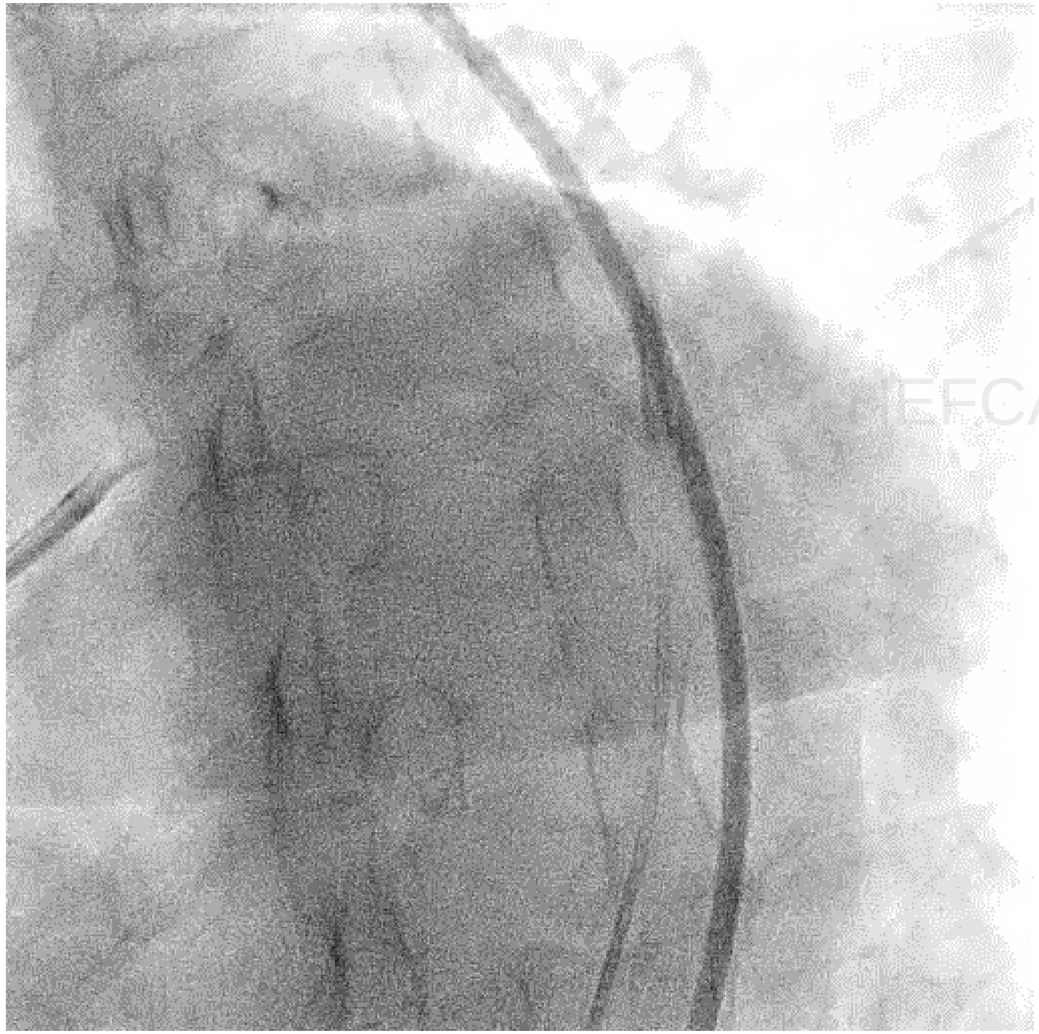
Female, 58 yo

- **Ischemic Cardiomyopathy**
- **CVRF** : HT
- **Heart team discussion + family IC**
- **Echo:** LVEF 26%, RWMA (+)
- **CMRI**
  - Transmural infarction at inferior
  - Subendocardial infarction:
  - 50% transmurality inferoseptal – anteroseptal
  - 25-50% transmurality: anterior, anterolateral

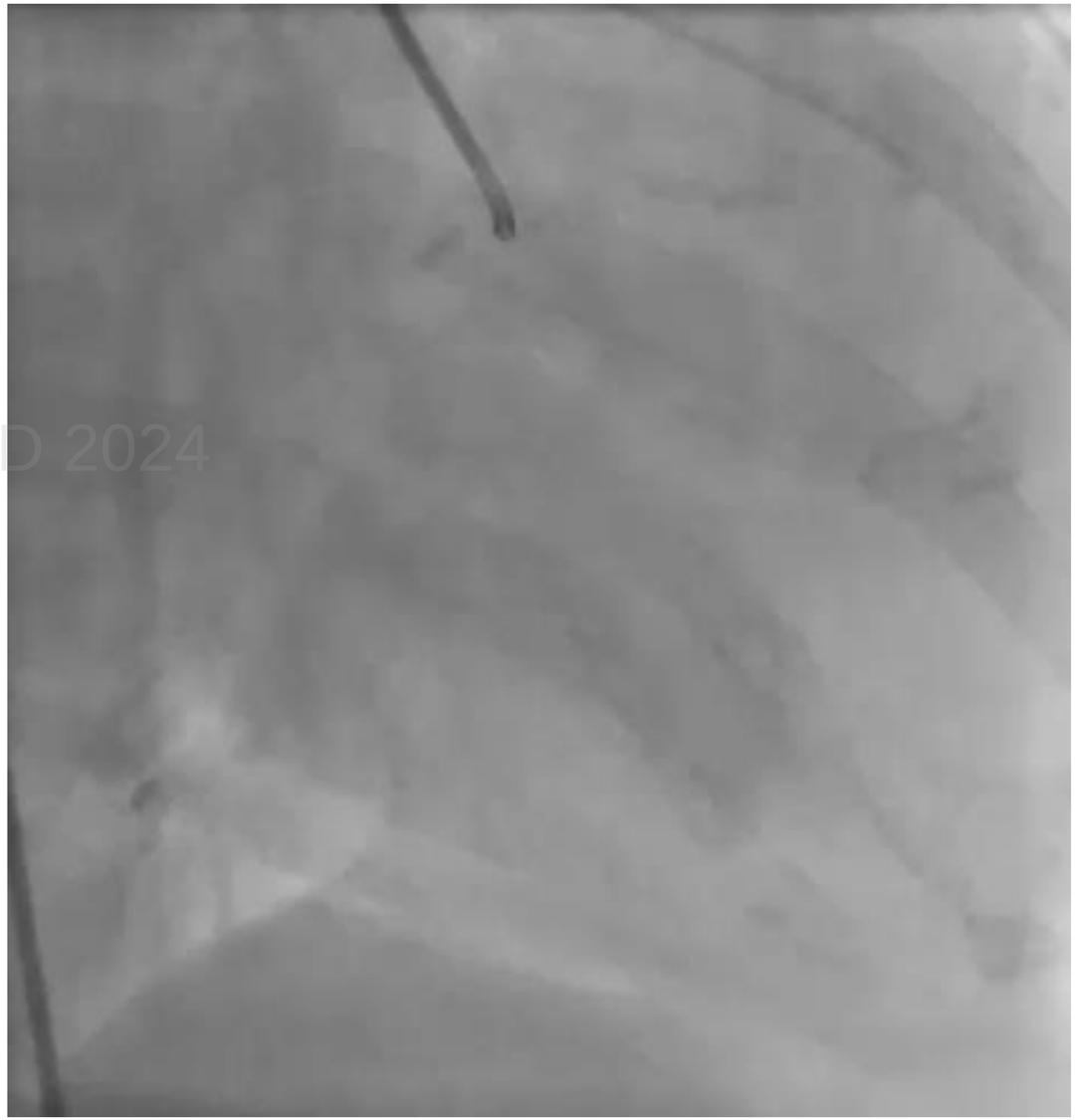
Left coronary angiogram

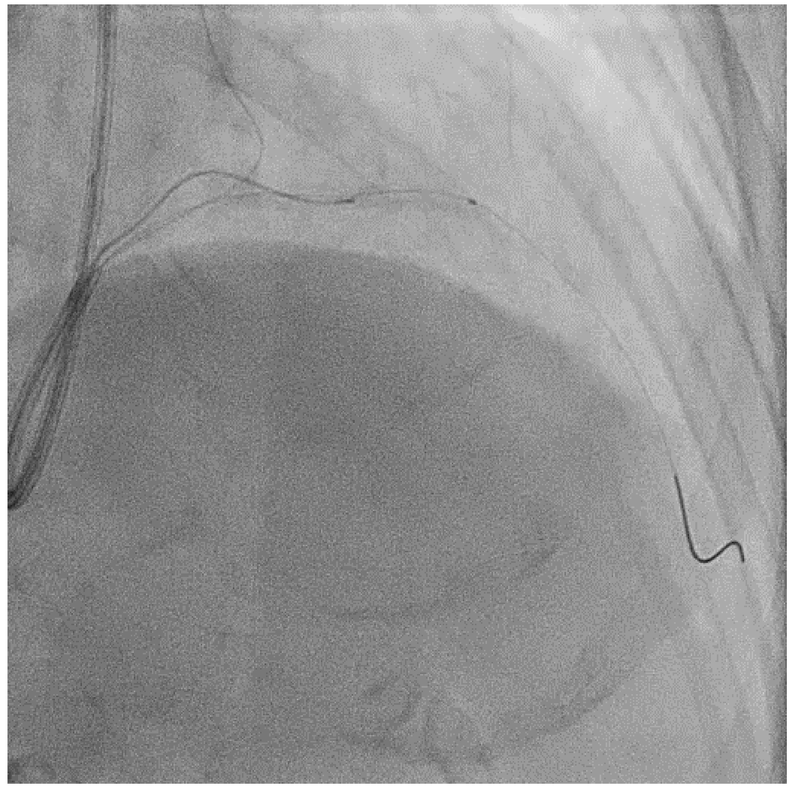
IABP support

Syntax score 28, Euroscore 4.31%



Right coronary angiogram

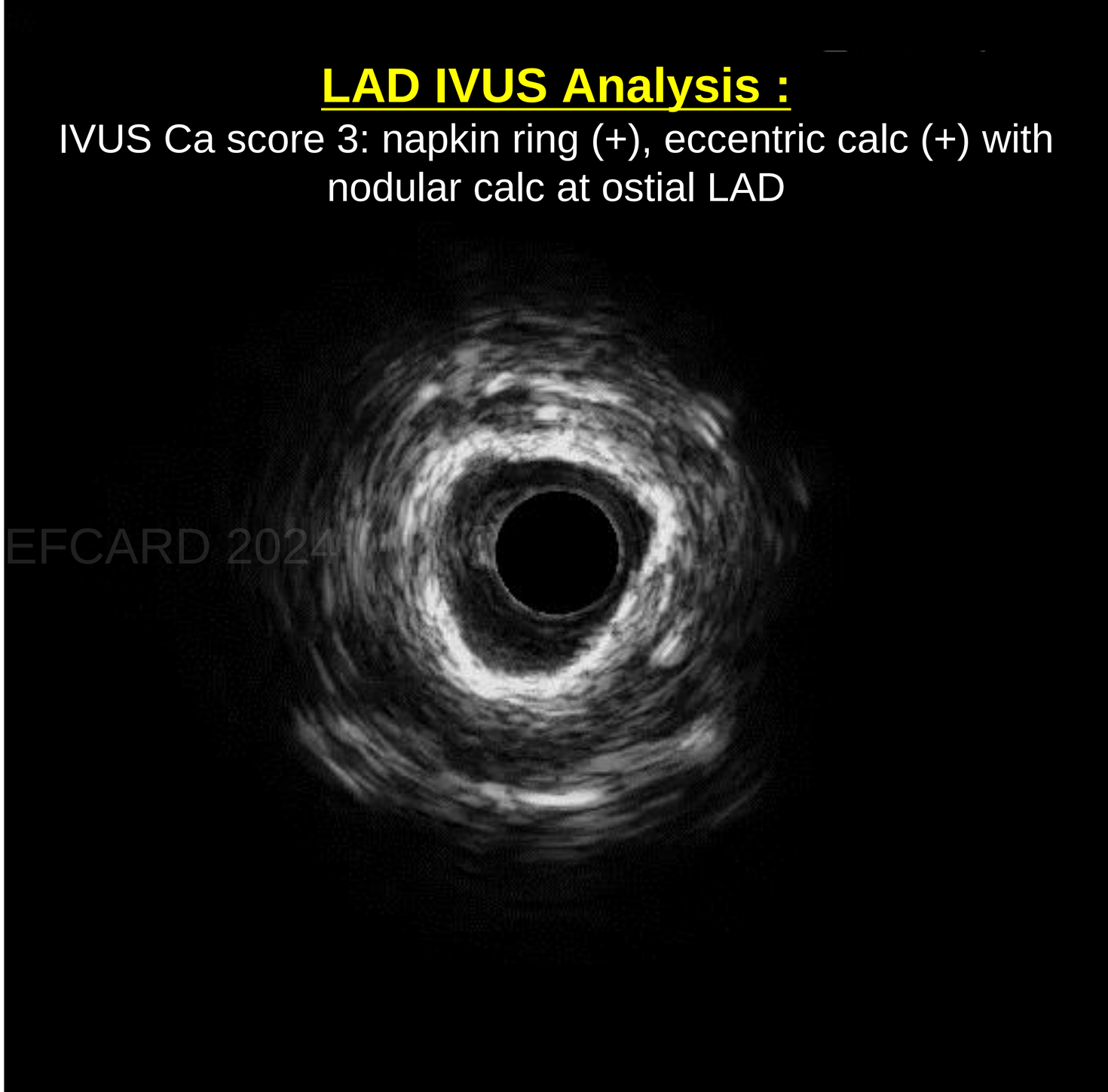




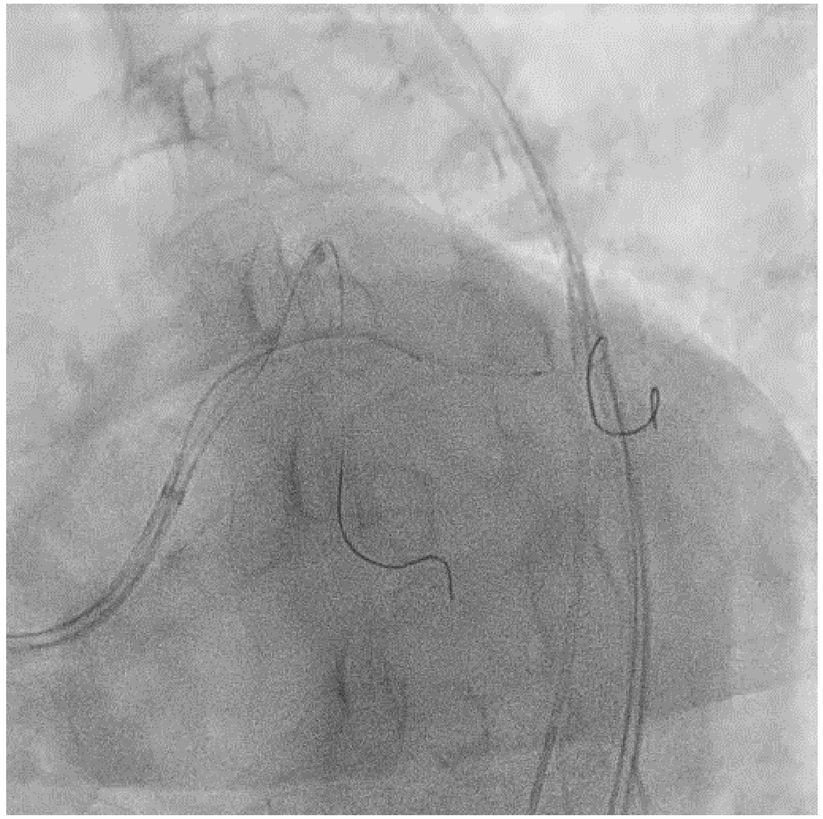
IVUS catheter could not advanced more distal

LAD IVUS Analysis :

IVUS Ca score 3: napkin ring (+), eccentric calc (+) with nodular calc at ostial LAD



IVUS study
LM - LCx

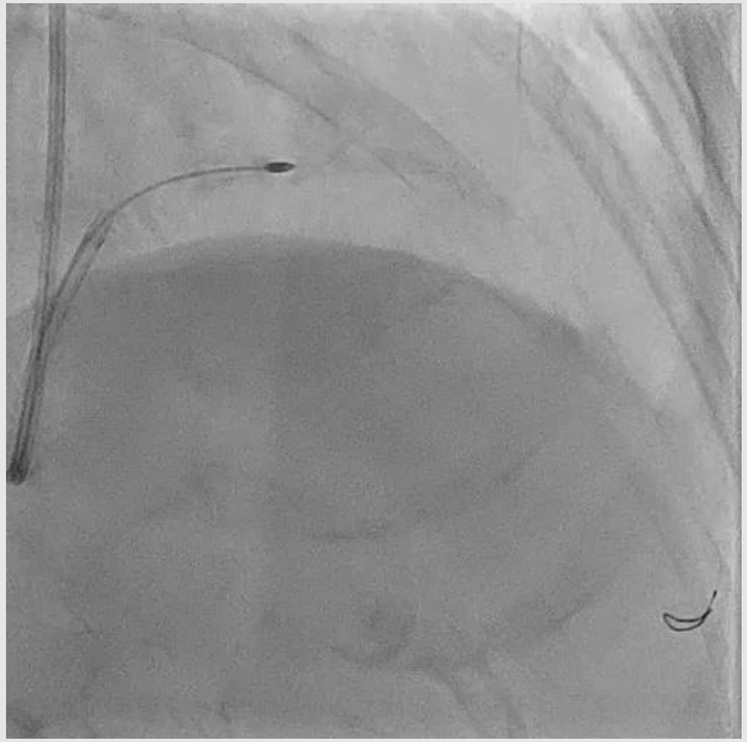


LCx IVUS Analysis :

Nonsignificant lesion

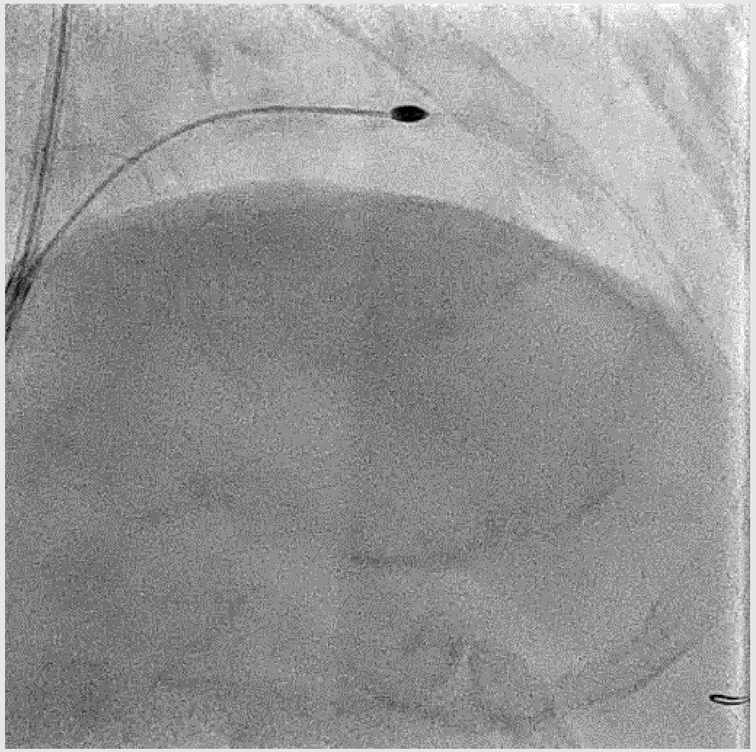
Rotablation

Rotaburr 1.5 mm/ 190KRPM



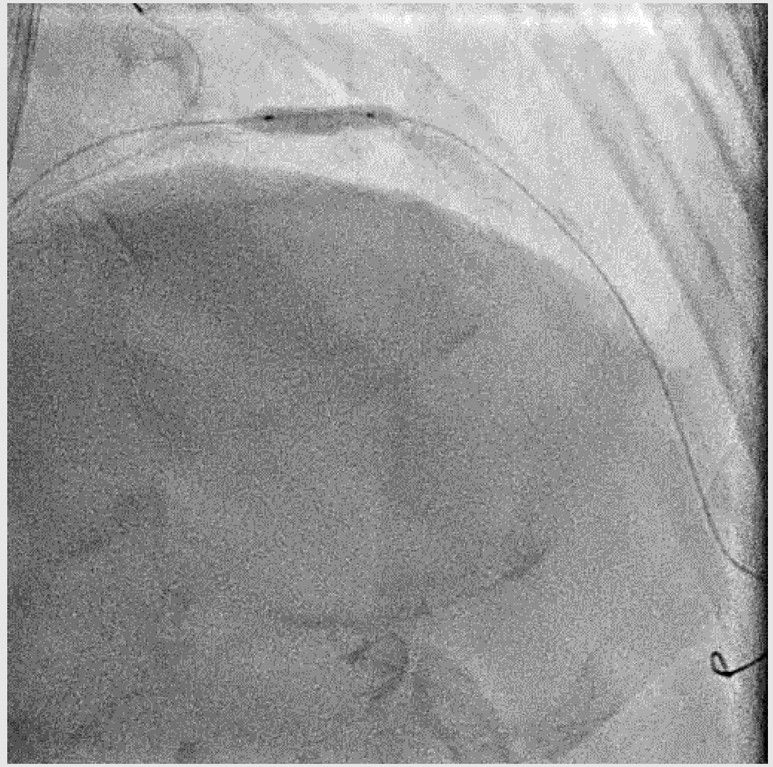
Rotablation

Rotaburr 2.0 mm/ 160KRPM



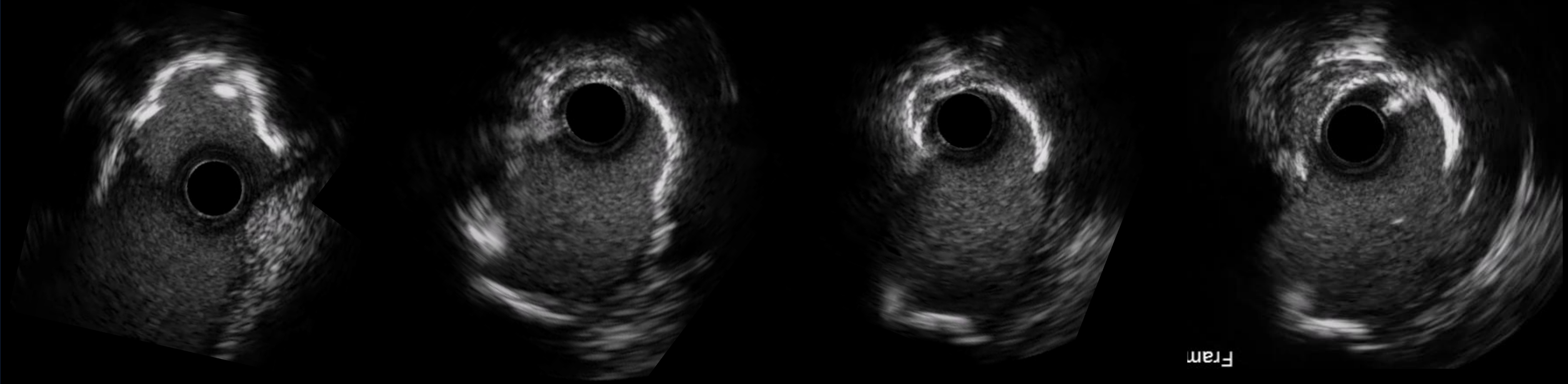
Predilate

3.0/10mm CB



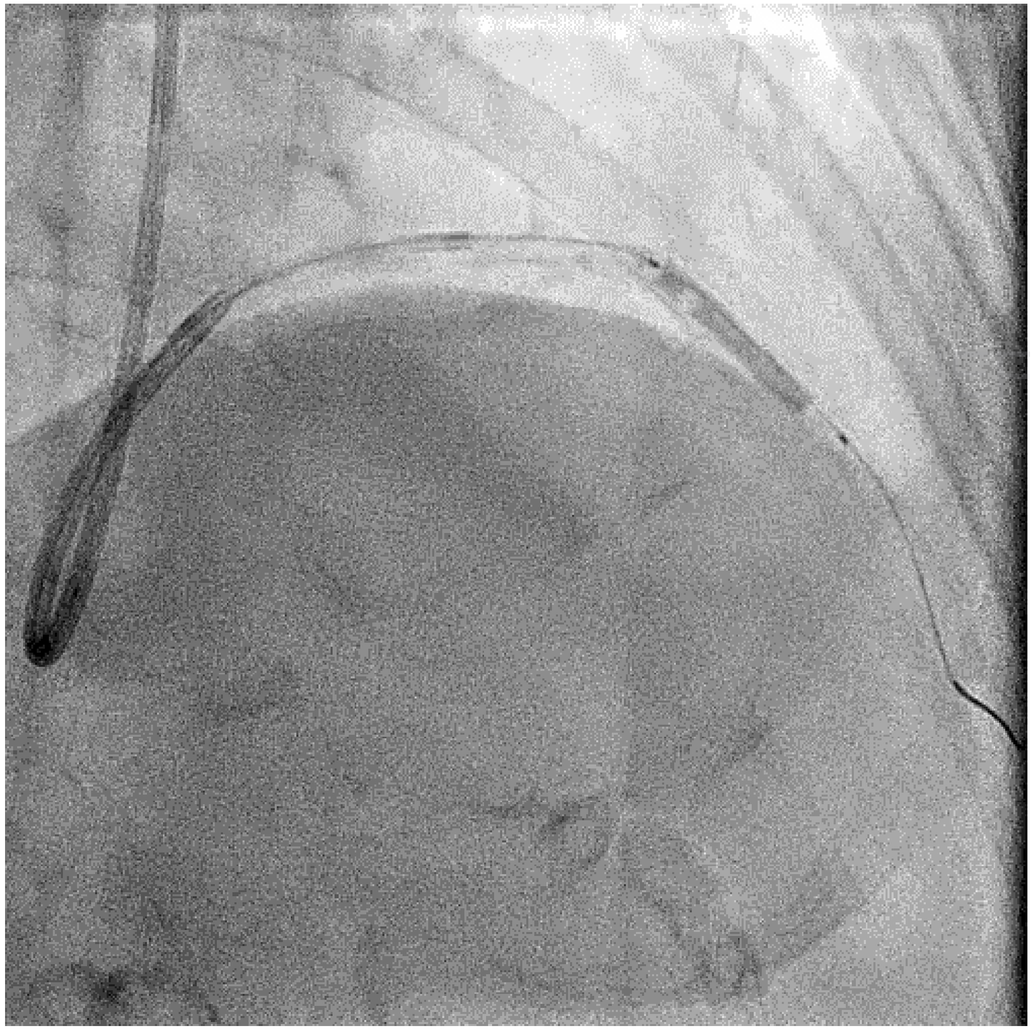
IVUS evaluation (Ostial LAD)

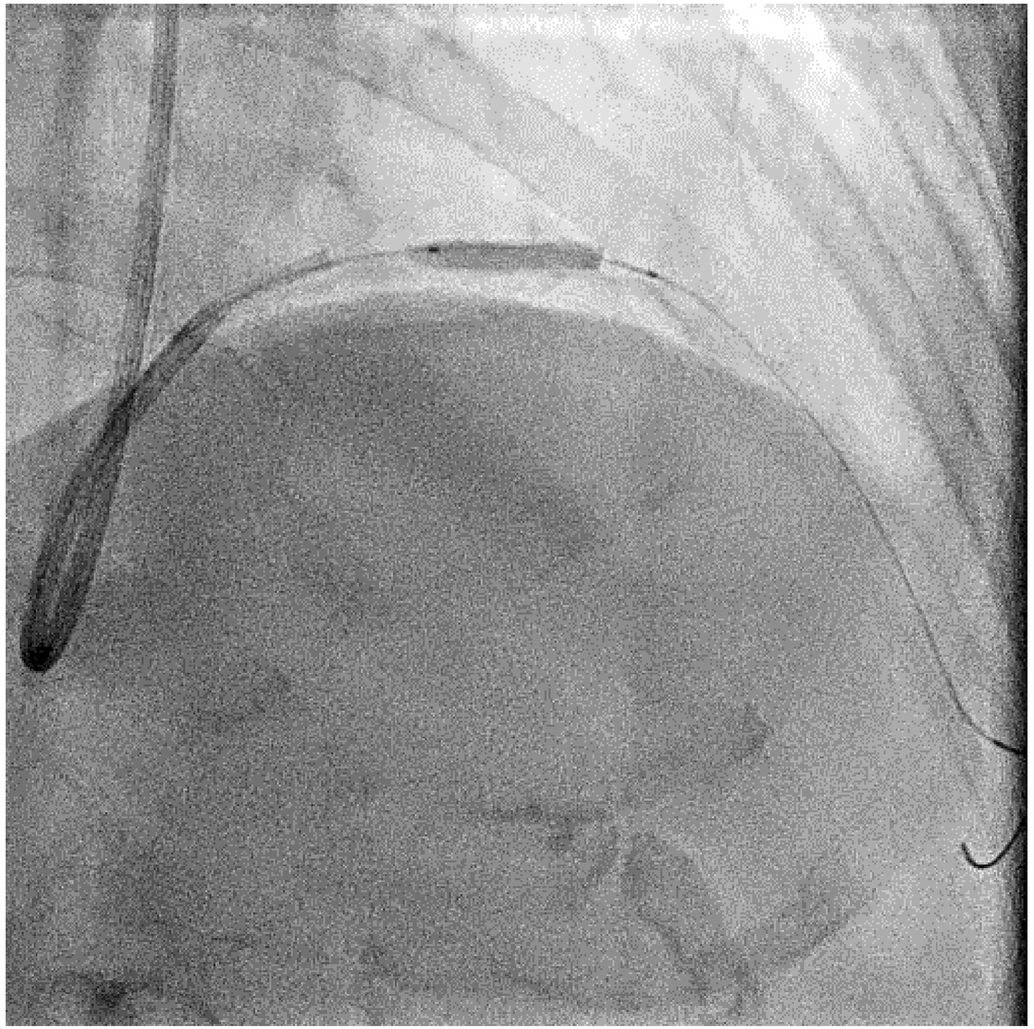
Post Rota 1.5mm/190KRPM → Post Rota 2.0mm/160KRPM → Post CB 3.0mm → Post NC 3.5mm



DCB 2.75/25 mm
(8 atm 60 sec)

DCB 3.0/20 mm
(8 atm 60 sec)

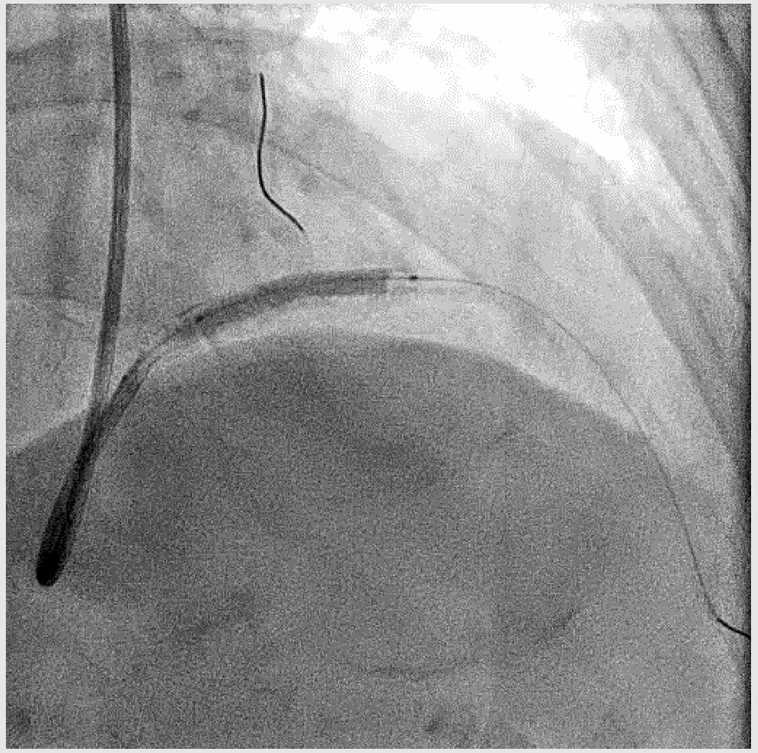




Left Main Provisional Stenting

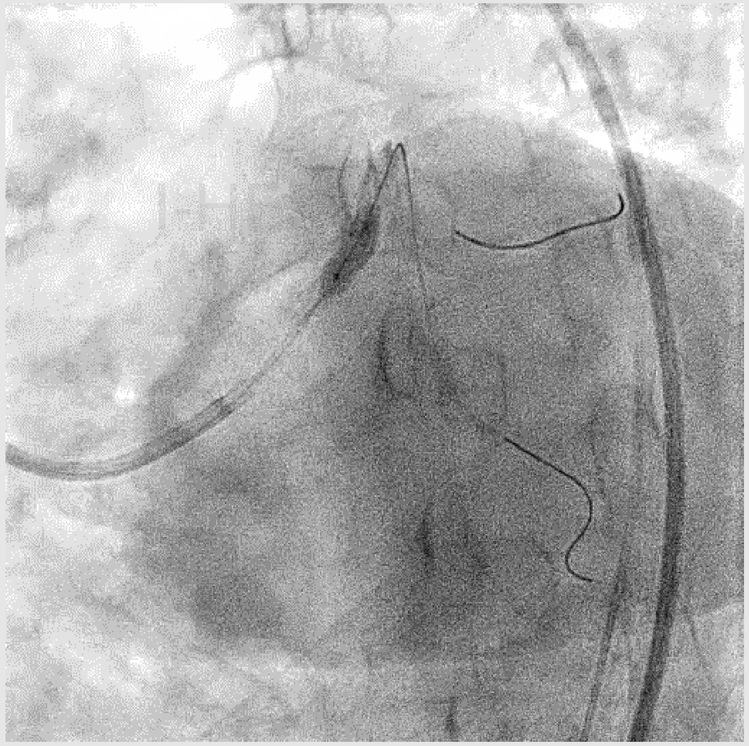
Crossover stenting

3.5/28mm DES

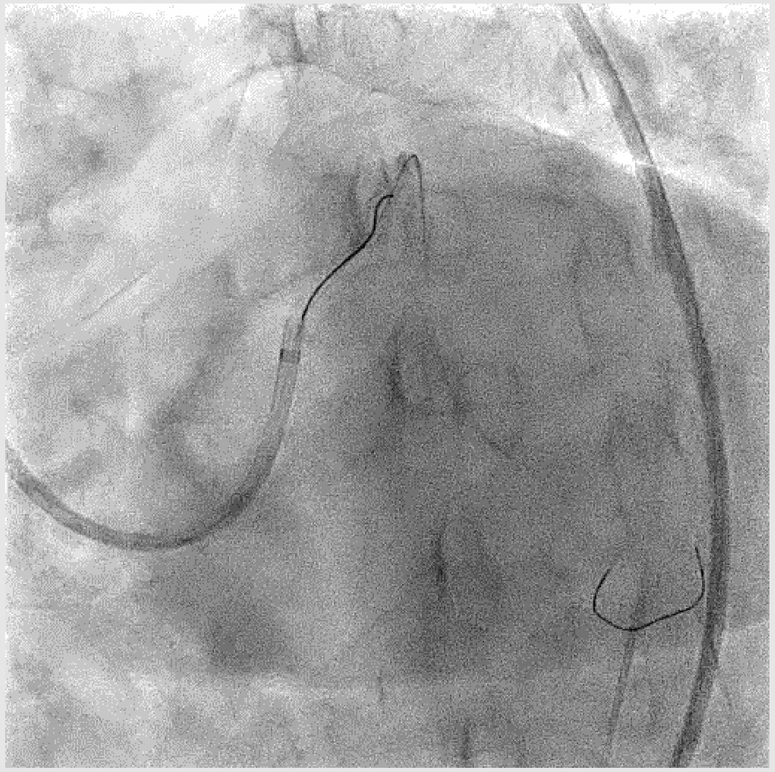


POT

4.5/12mm NCB (24 atm)

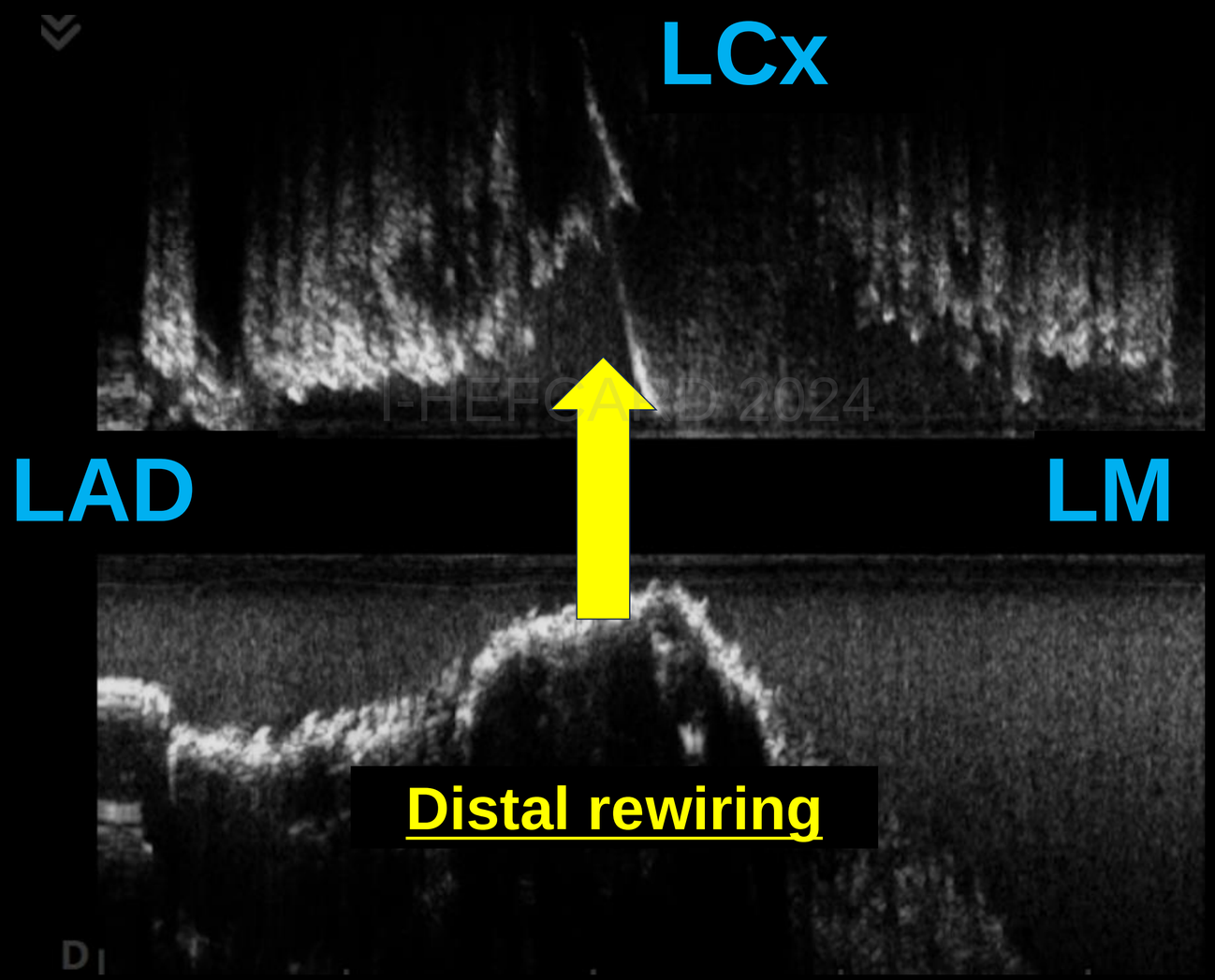


Rewiring LCx



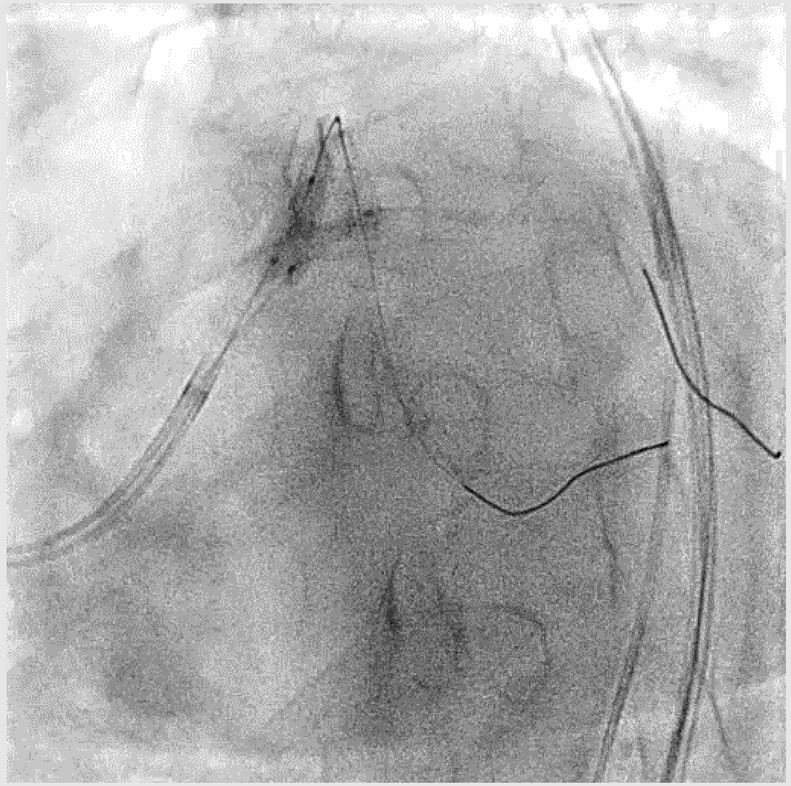
LM – LAD IVUS study

After LCx rewiring



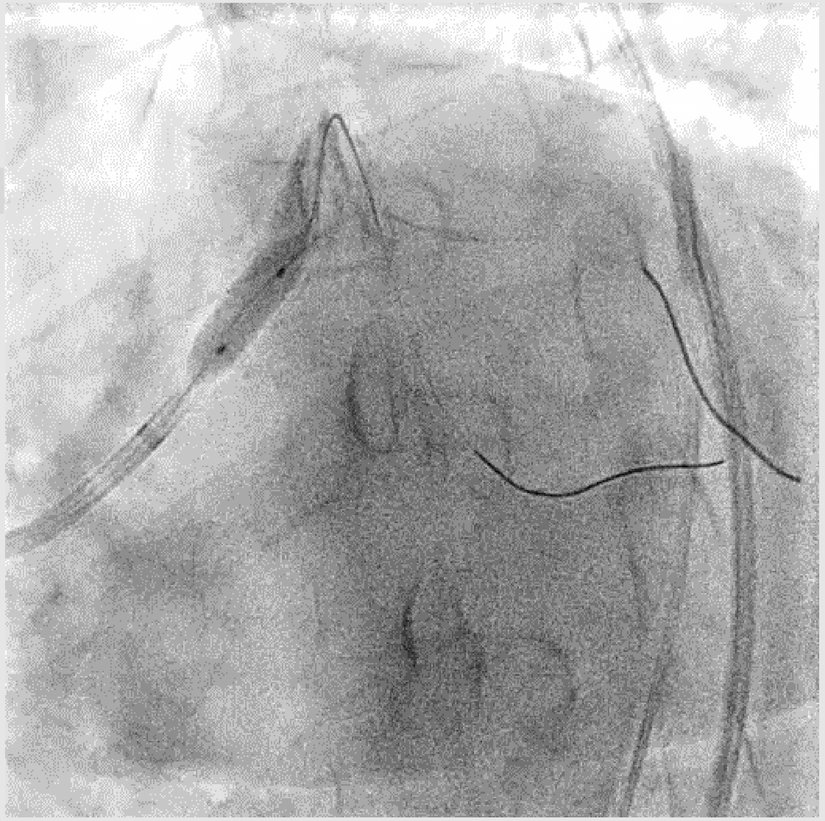
KBI

LM – LAD: 3.0/15 mm NCB
LM – LCx: 3.0/12 mm NCB



Re - POT

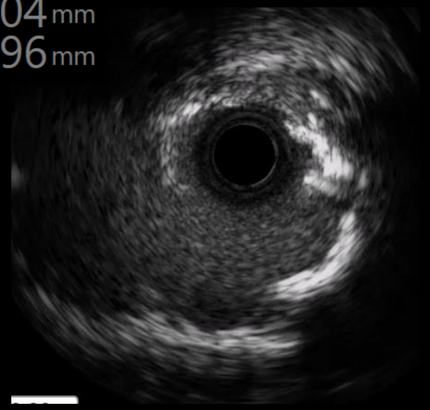
4.5/12 mm NCB



Final IVUS study

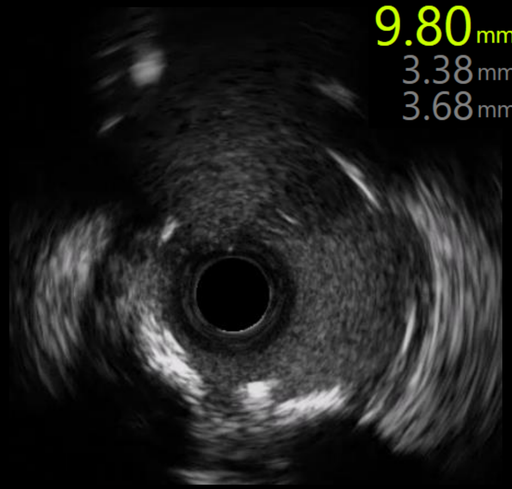
MSA Ostial LAD

9.98 mm²
3.04 mm
3.96 mm



MLA Ostial LCx

9.80 mm²
3.38 mm
3.68 mm



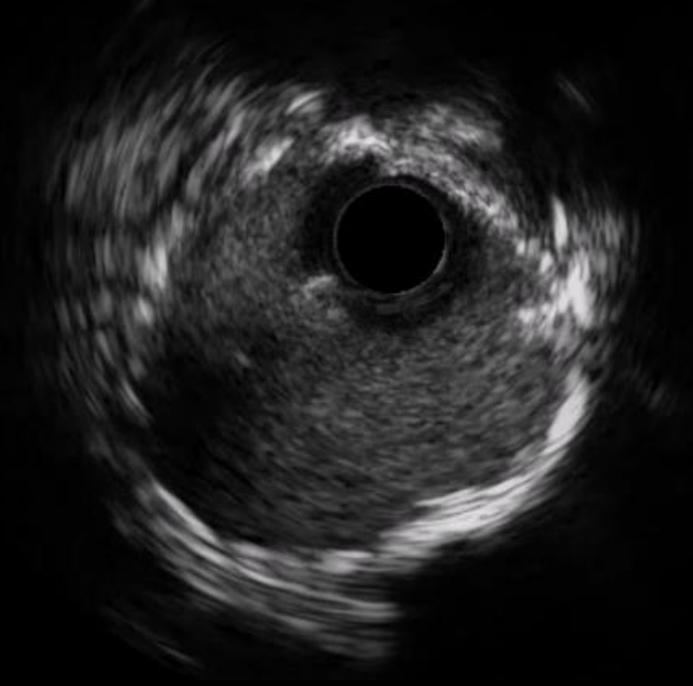
MSA POC

11.54 mm²
3.34 mm
4.23 mm

No jailed strut at ostial Cx

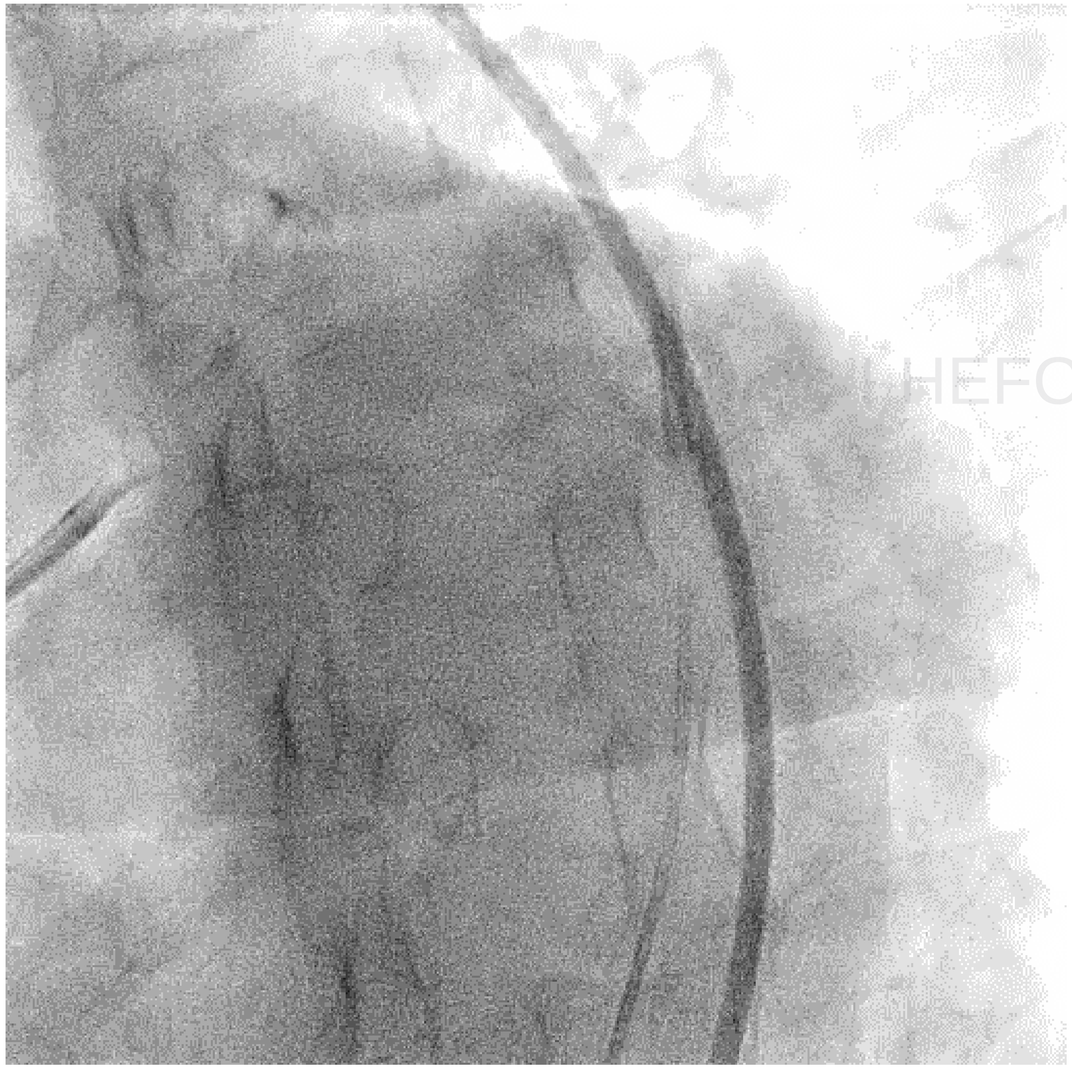
MSA LM

12.27 mm²
3.69 mm
4.35 mm

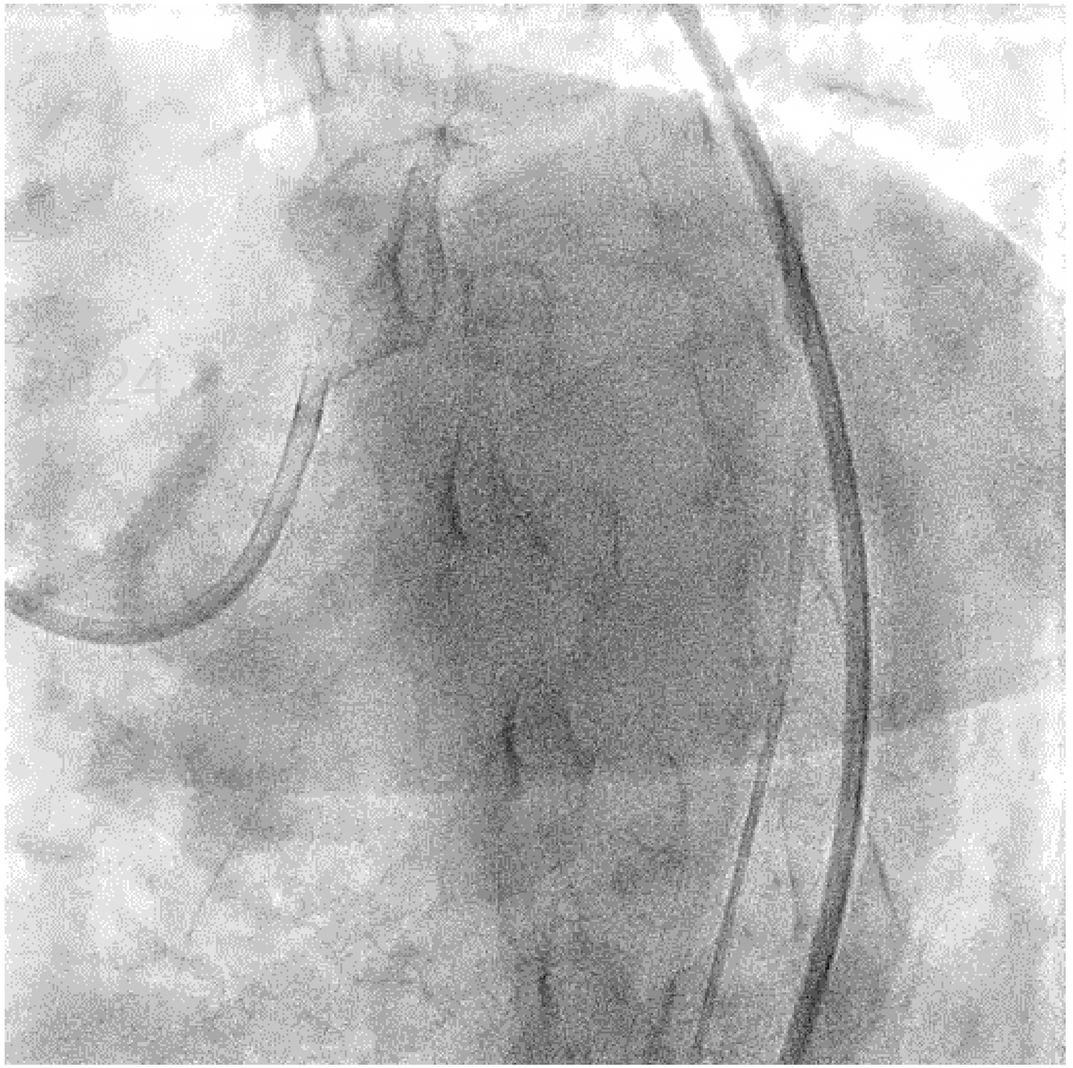


Final results

Pre PCI

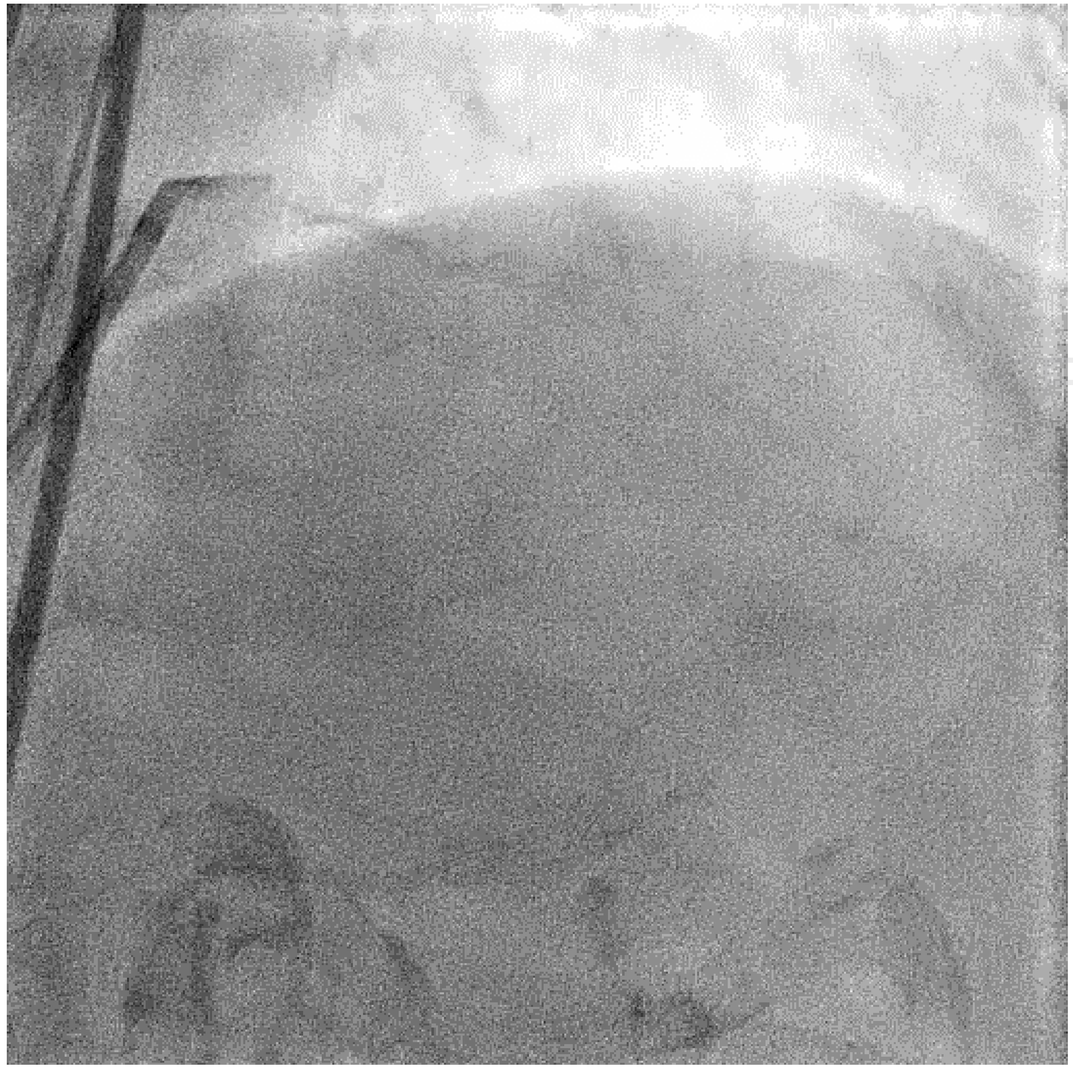


Post PCI

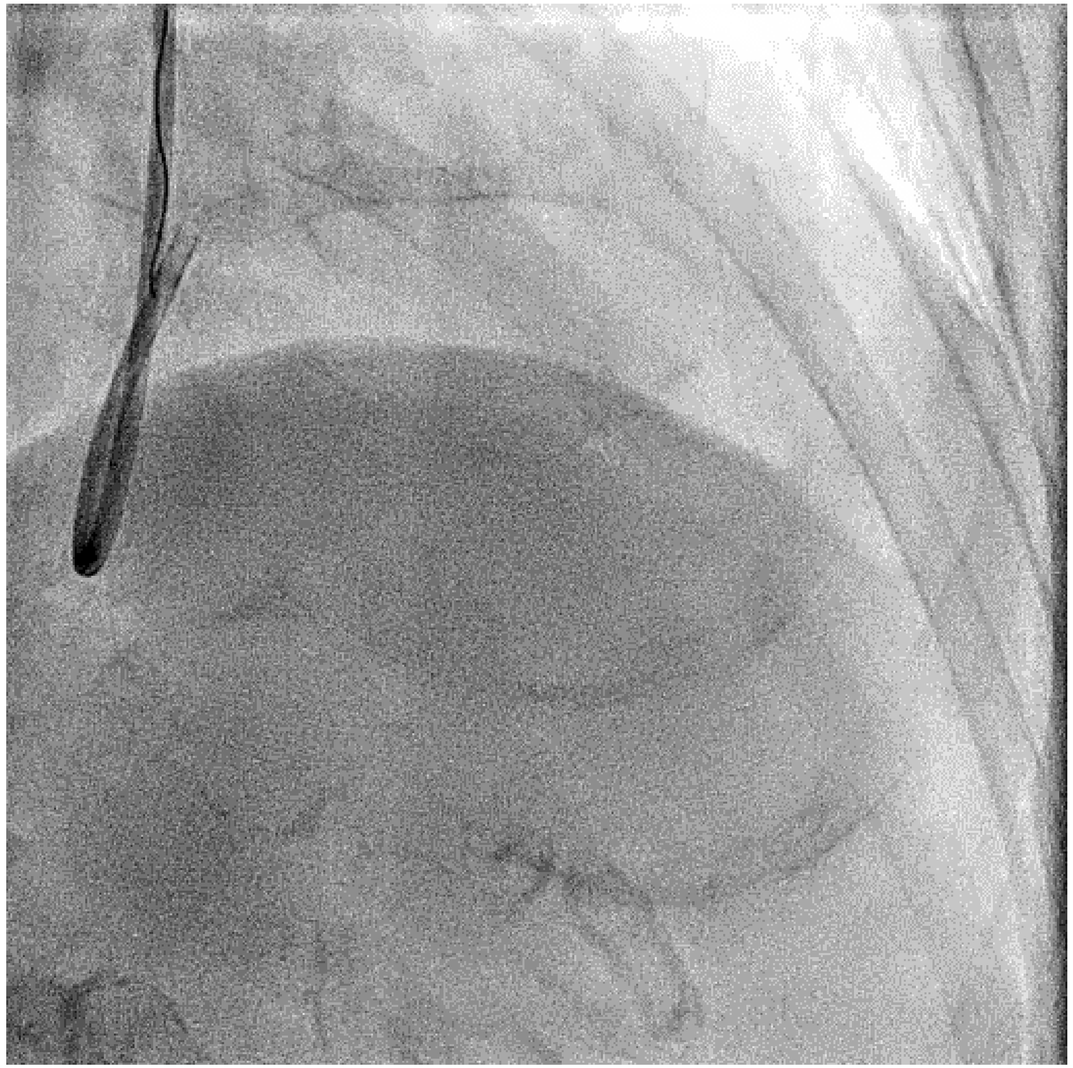


Final results

Pre PCI



Post PCI

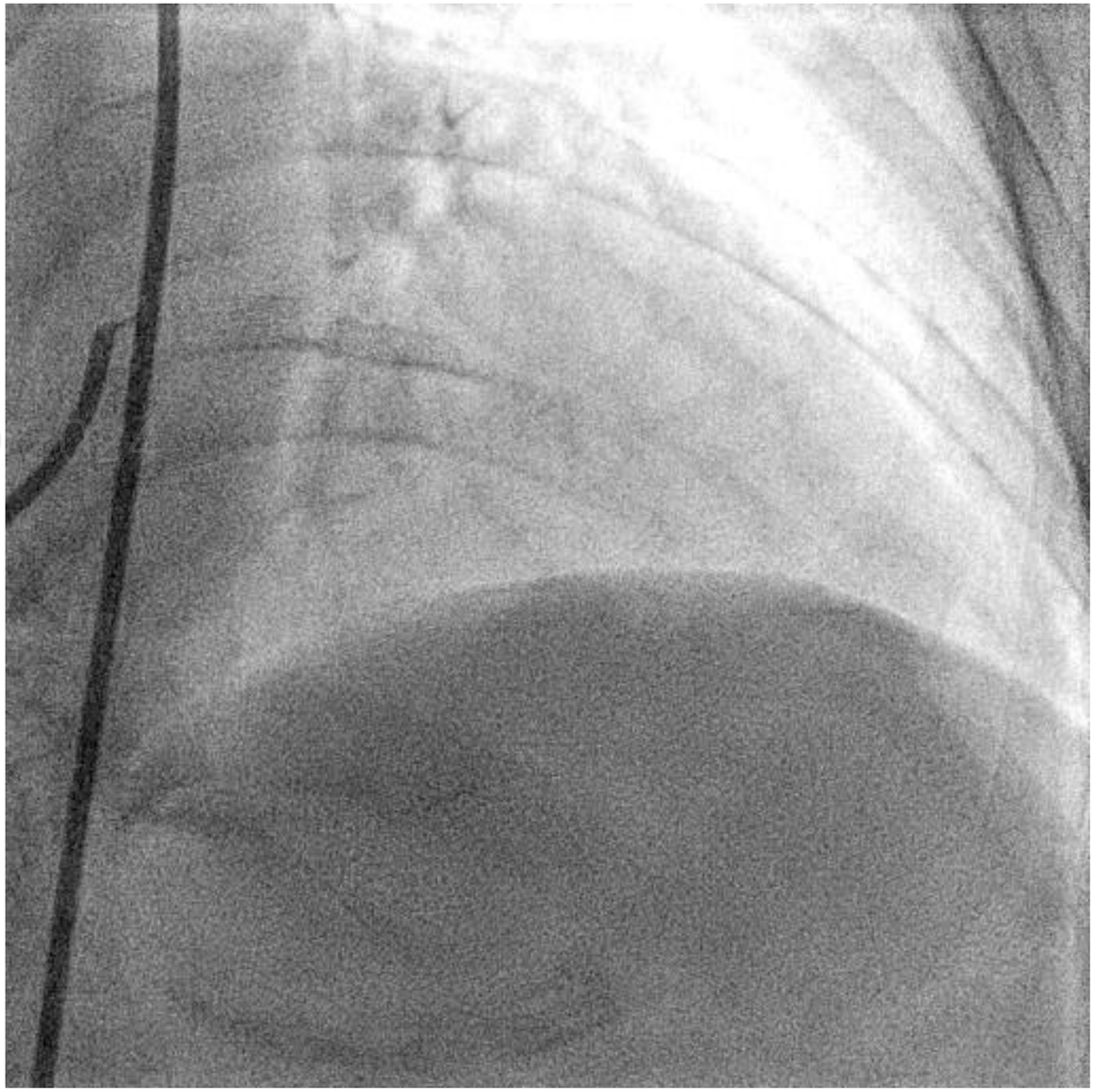


Case 2

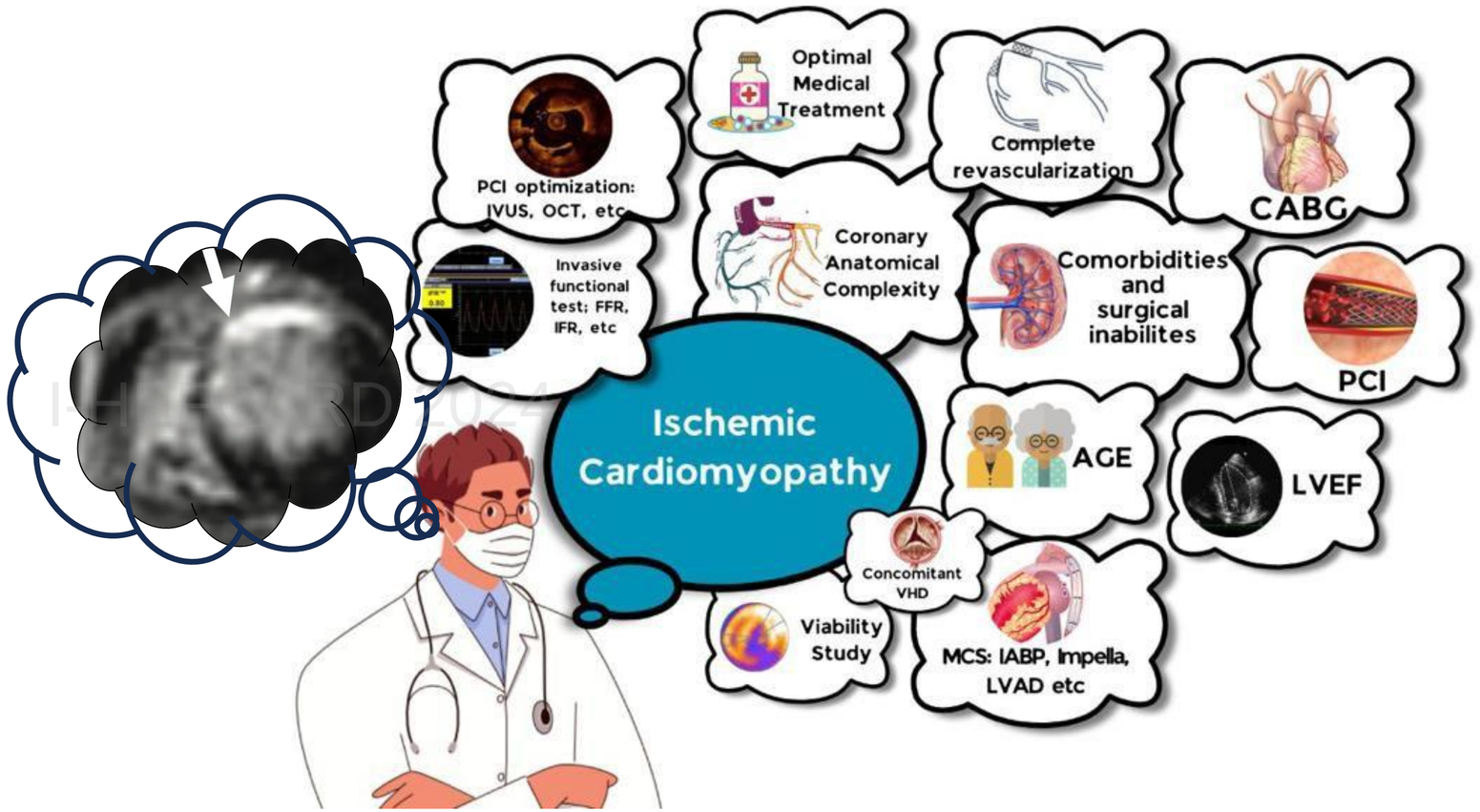
FU Echo:

LVEF 26% → 41%

Six months Follow up



Take home messages



PCI in Ischemic Cardiomyopathy

“Opportunity is often Delivered in a Fog of Uncertainty”
(JK-Zinn)

Thankyou