Incomplete Revascularization IS Enough !

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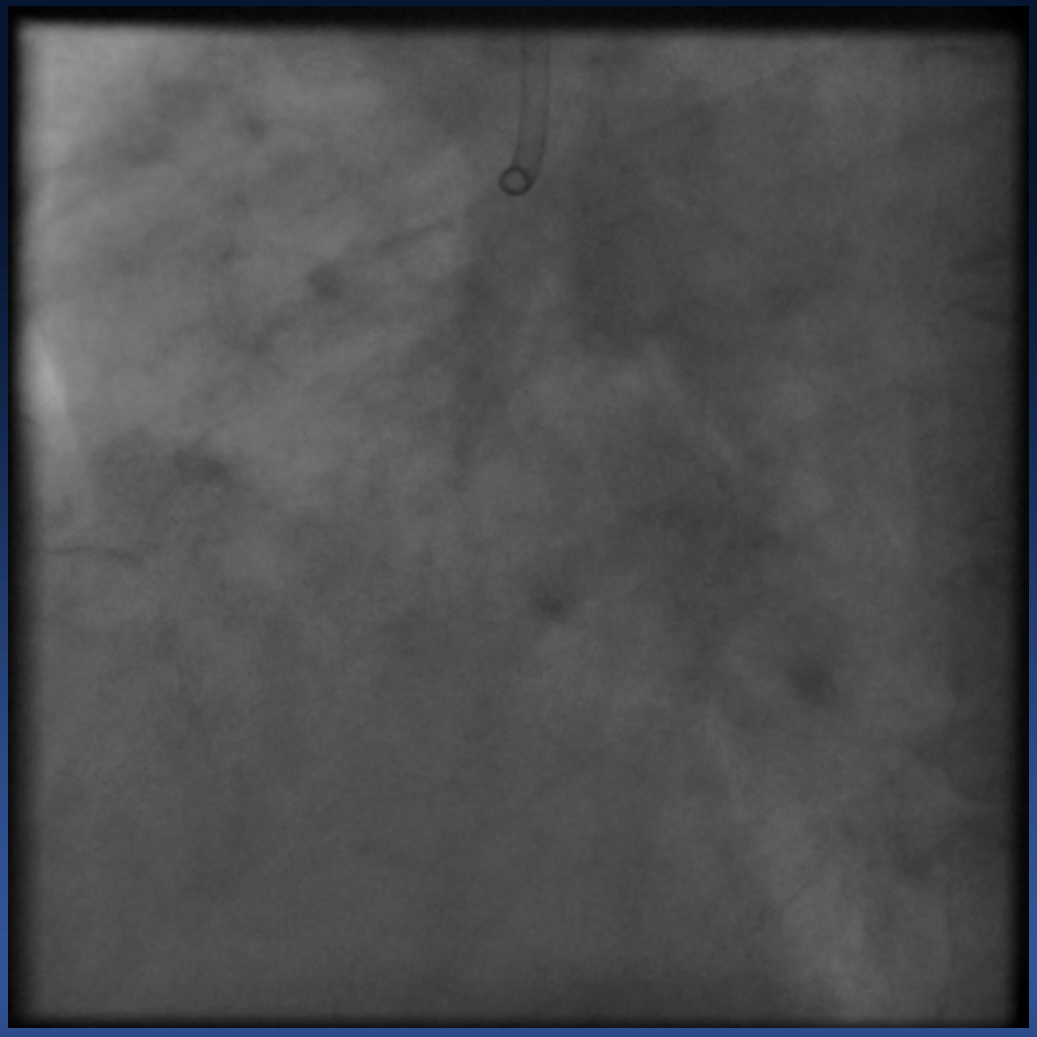
Multivessel (Multilesion) CAD

- ACS patients : consensus
  - Culprit-lesion intervention followed by function-guided non-culprit revascularization
- Stable angina patients :debated
  - Complete vs. Incomplete
  - Anatomy-guided vs. Function-guided

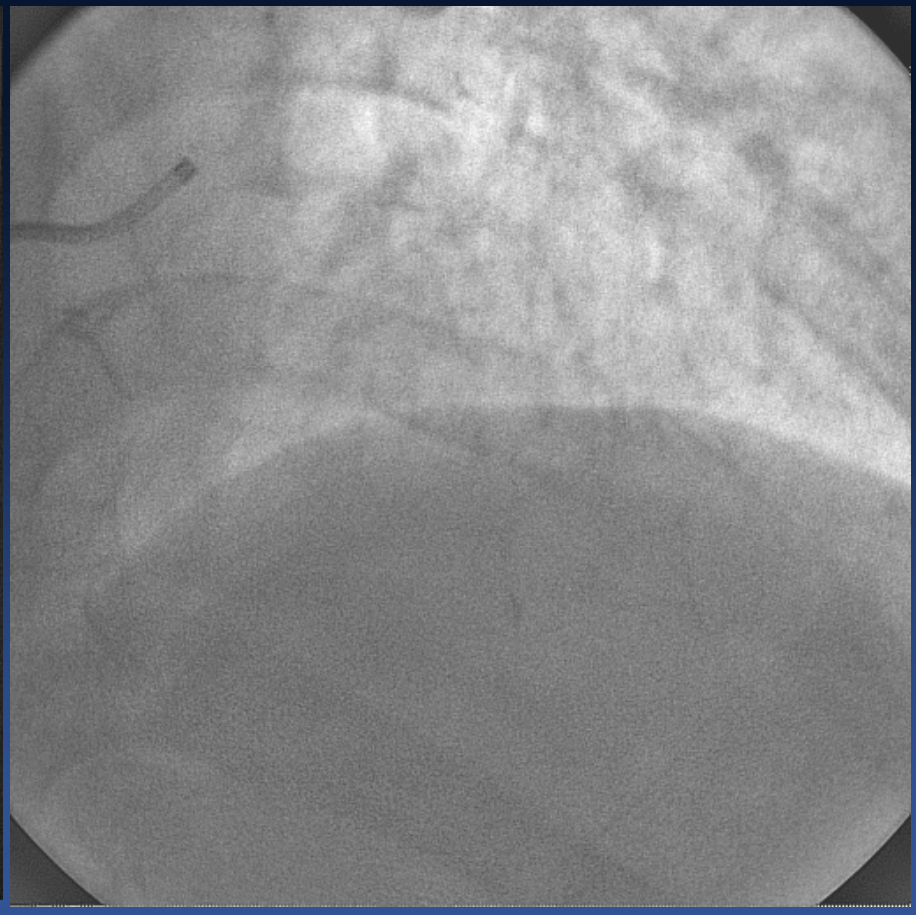
Case: Stable Angina

- F / 72
- Recent onset chest pain for 1 month
- Multiple stenosis including LM by coronary CT in another hospital
- Normal EKG
- Normal echocardiography with 65% of LV EF
- Good exercise performance before symptom
- No coronary risk factor

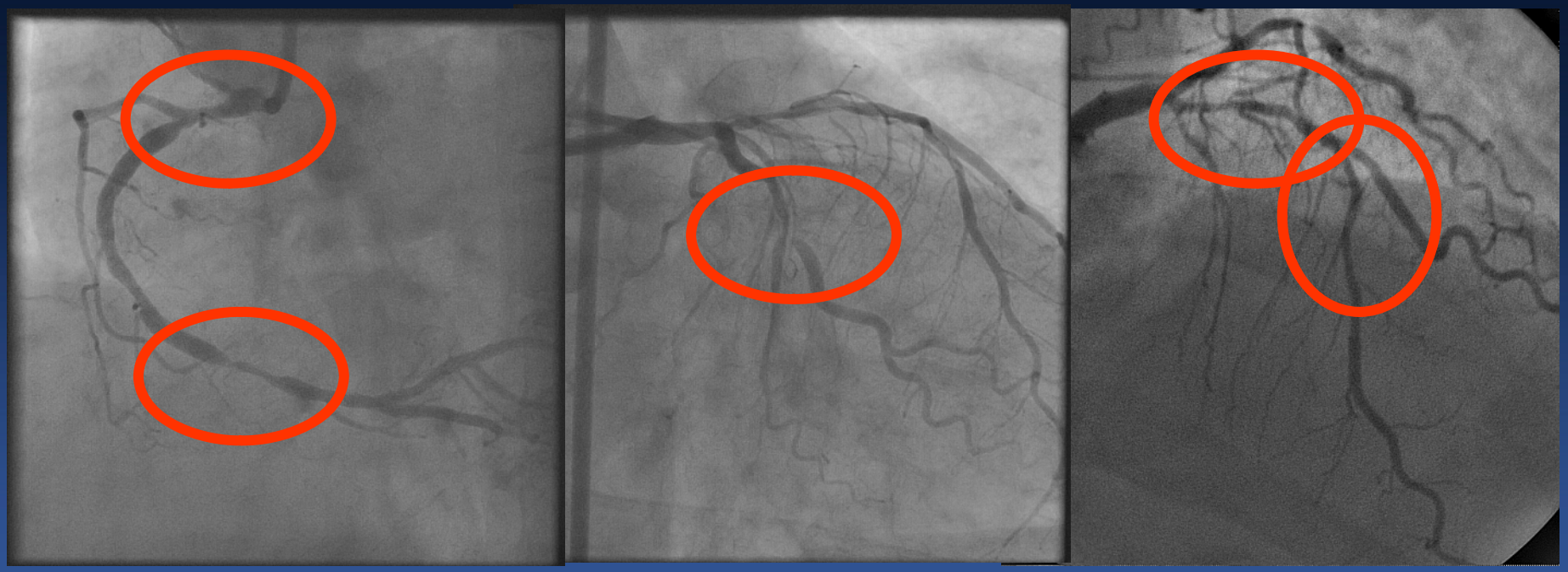
Coronary Angiogram



Coronary Angiogram

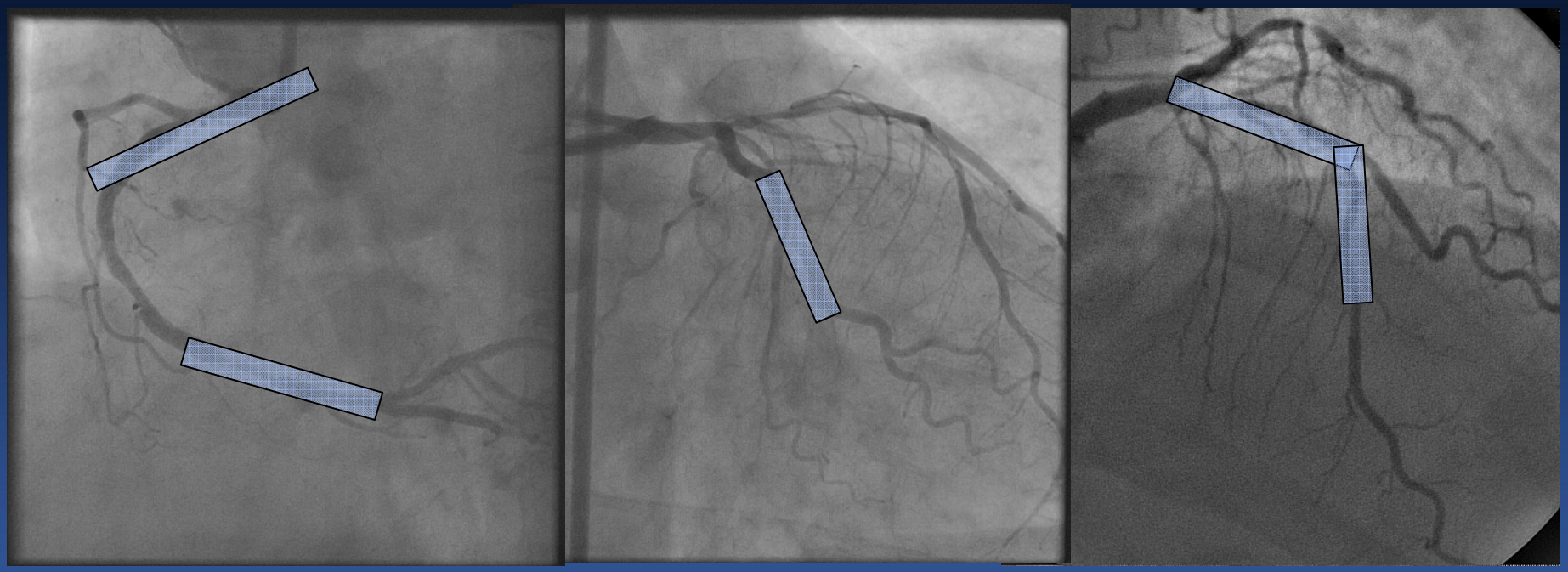


Coronary Angiogram
SYNTAX Calculation = 24



Simulation

Complete Revascularization using at least 5 stents



ESC 2011 and ACC 2011 Update
PCI vs. CABG

	<< CABG		<< PCI	
Subset of CAD by anatomy	**ESC**	**ACC**	**ESC**	**ACC**
1VD or 2VD – non-proximal LAD	**IIbC**	**IIa B**	**IC**	**IIb B**
1VD or 2VD – proximal LAD	**IA**	**IA**	**IIa B**	**IIa B**
3VD simple lesions, full functional revascularization achievable with PCI,SYNTAX score>22	**IA**	**IB**	**IIa B**	**IIb B**
3VD complex lesions, incomplete revascularization achievable with PCI,SYNTAX score>22	**IA**	**-**	**III A**	**-**
Left main (isolated or 1VD, ostium/shaft)	**IA**	**IB**	**IIa B**	**IIa B**
Left main (isolated or 1VD, distal bifurcation)	**IA**	**IB**	**IIb B**	**IIb B**
Left main + 2VD or 3VD, SYNTAX score≤32	**IA**	**IB**	**IIb B**	**IIb B**
Left main + 2VD or 3VD, SYNTAX score≥33	**IA**	**IB**	**III B**	**III B**

Predictors of Mortality in the CASS Registry (CABG Patients)

Predictors of Mortality
CHF Score
LV Wall Motion Score
Number of Assoc Diseases
Age
Number of Prox Vessels Diseased
LVEDP
Unstable Angina
<3 Vessels Bypassed

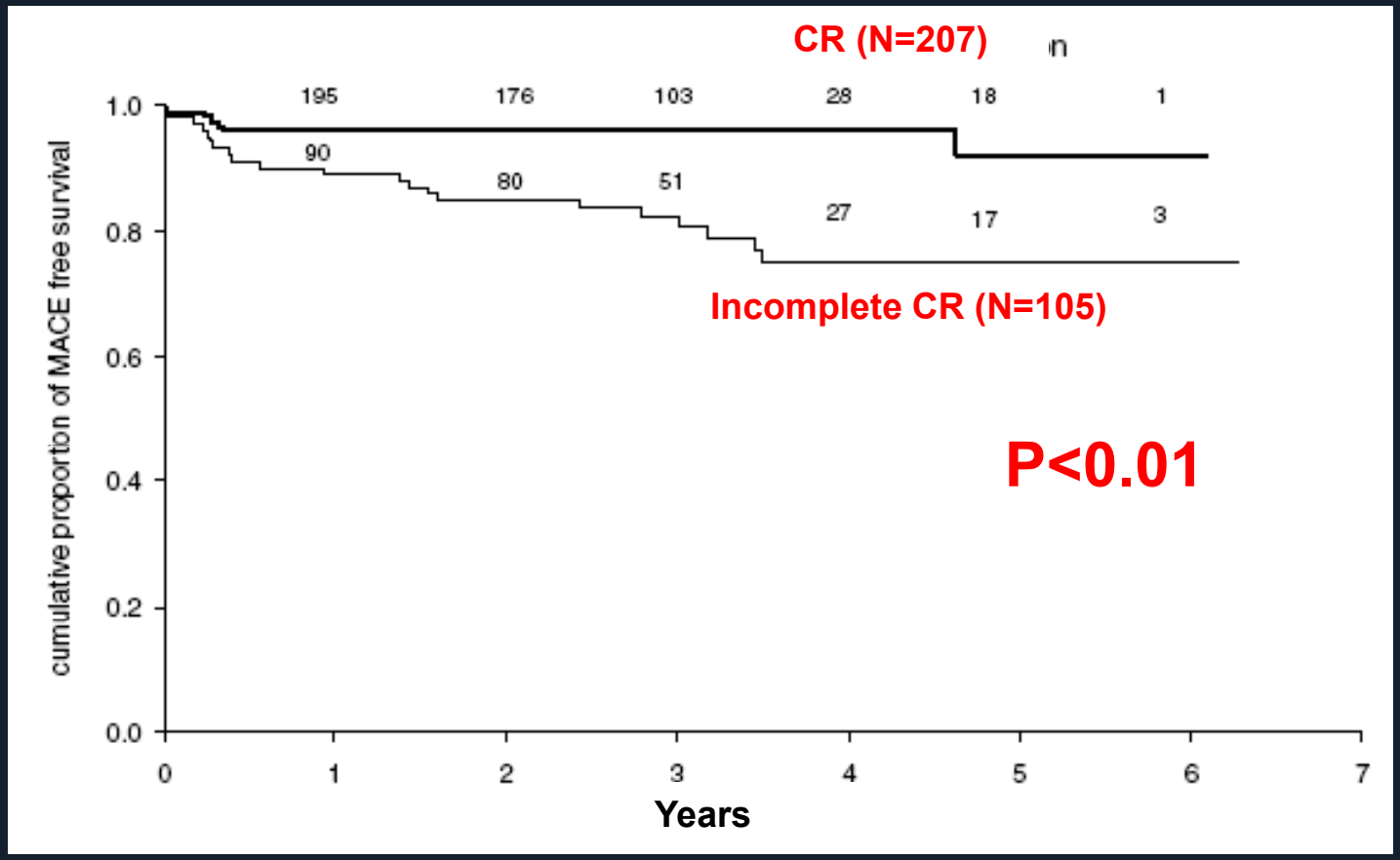
CR was associated with the greatest improvements in outcome among:

- *Pts with more severe angina*
- *Pts with reduced LV function*

Bell et al, Circulation 1992

Impact of CR after CABG Surgery

For Death, UA, MI, Hospitalization, & Repeat revascularization -free Survival

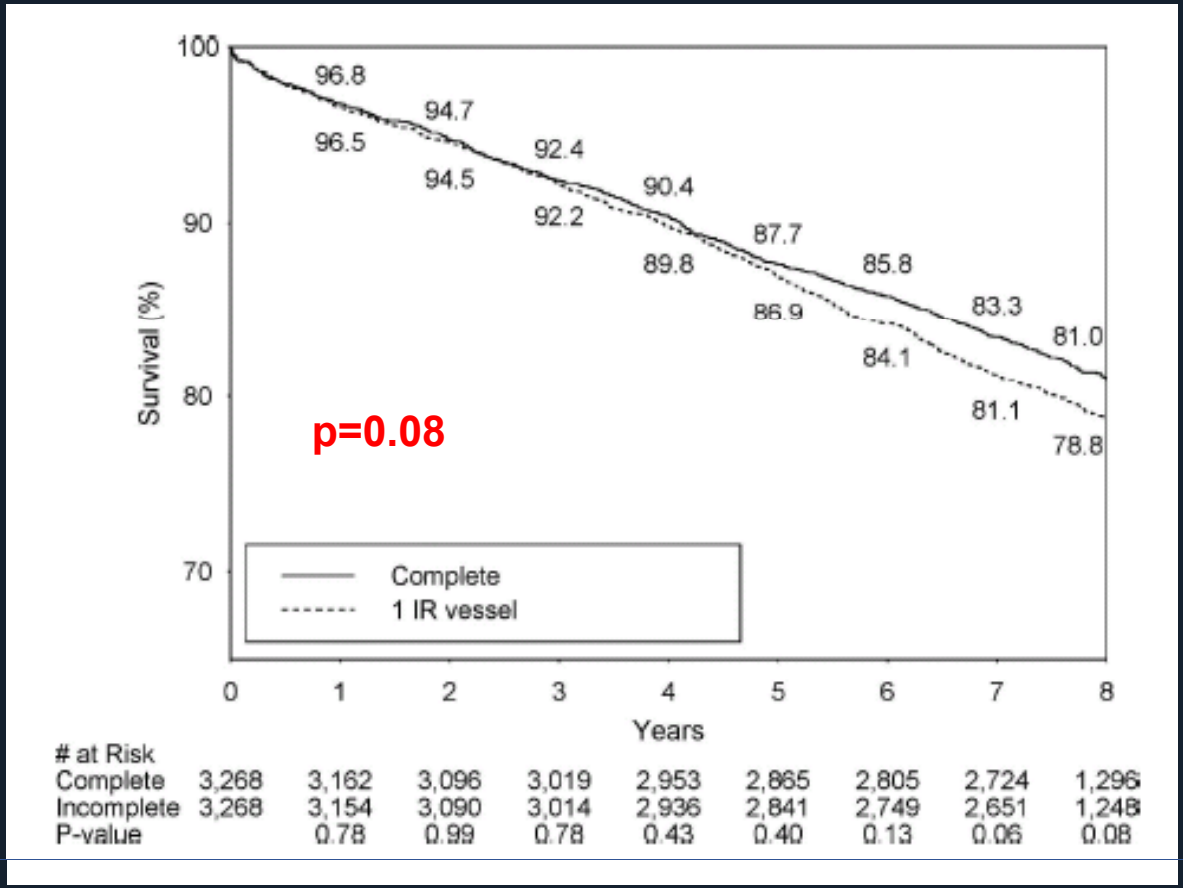


Agostini M et al. J Card Surg 2009;24:650

NY State PCI Database (1999-2000)

Impact of CR for Mortality in BMS Era

Propensity Matching from 13,016 Pts



Wu C et al, *Circ Cardiovasc Interv. 2011;4:413*

NY State PCI Database (2003-2004)

Impact of CR for Mortality in DES Era

Revascularization was Incomplete in 69%

	N	Adjusted HR of IR compared with CR
CR	3499	
IR (All)	7795	1.23 (1.04,1.45)
1 IR with no CTO	3815	1.23 (1.02,1.48)
1 IR vessel is CTO	1725	1.11 (0.87,1.42)
≥2 IR, no CTO	1233	1.18 (0.89,1.56)
≥2 IR, ≥1 CTO	1022	1.44 (1.14,1.82)

Hannan EL et al, *JACC: Cardiovasc Intv 2009*

Debate about this issue of CR

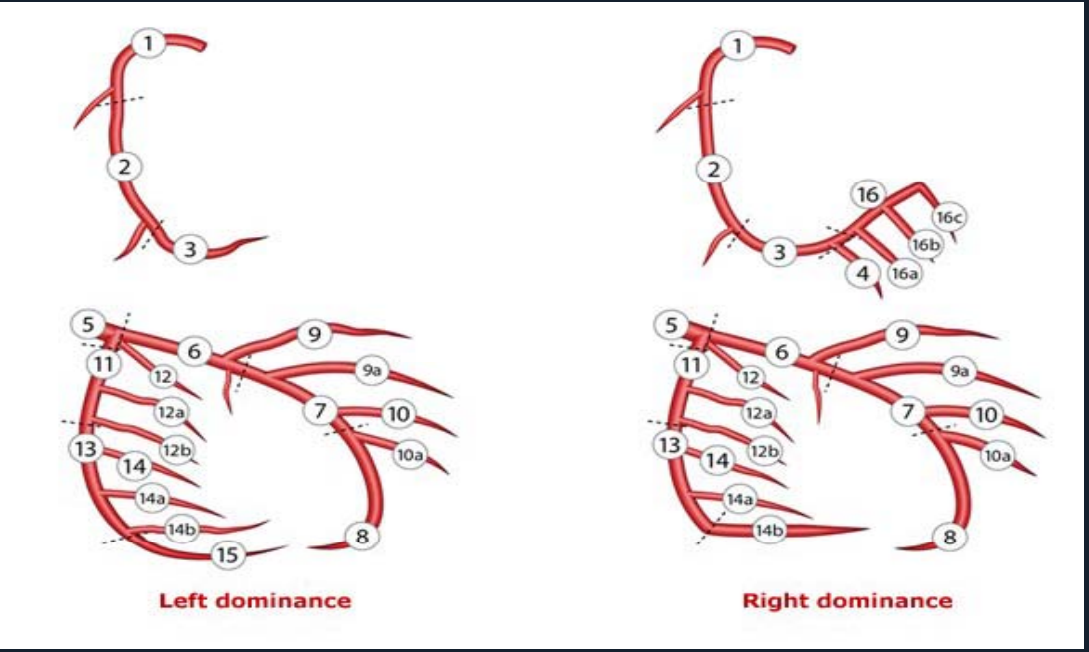
Hardly answer properly because…

- Various definitions about CR
- Different outcomes according to the diverse clinical presentations
- Heterogeneous patient's characteristics
- Mostly observational data, no randomized study

Definitions of CR

1914 (1400 PCI, 514 CABG) pts with MVD in AMC

- **Angiographic CR-1**
  - Revascularization of all SYNTAX segment (≥1.5 mm), consisting of RCA (# 1, 2 & 3), PDA (# 4 or 15), PL (# 16), LAD (# 5, 6, 7 & 8), Diag (# 9 or 10), LCX (# 11 &13), OM (# 12 or 14).



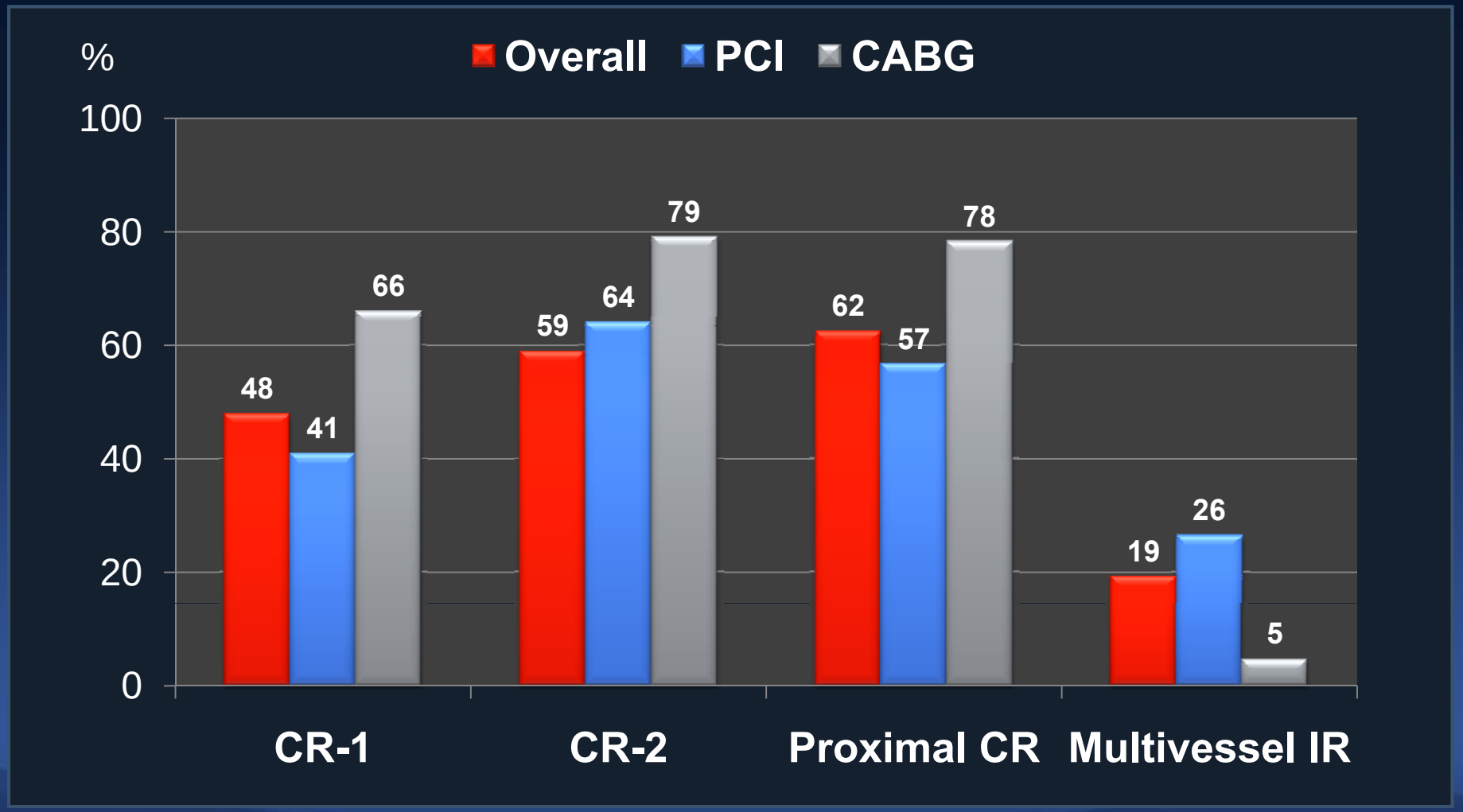
Kim YH et al. Circulation. 2011;123:2373

Definitions of CR in AMC

- **Angiographic CR-2**
  - Revascularization of all SYNTAX segment (≥ 2.5 mm)
- **Proximal CR**
  - Revascularization of all proximal arterial systems (# 1, 2, 3, 5, 6, 7 & 11)
- **Multivessel IR**
  - IR ≥ 2 diseased vessels
- The LM (# 5) was considered revascularized when the LAD was bypassed in the CABG group or directly treated percutaneously in the PCI group

Kim YH et al. Circulation. 2011;123:2373

Prevalence of CR
according to the Definitions



Angiographic Characteristics

Variable	PCI			CABG		
	CR (N=573)	IR (N=827)	P	CR (N=344)	IR (N=170)	P
SYNTAX score	15.0±7.1	19.0±7.7	<0.001	29.5±10.5	30.8±10.7	0.20
Angiographic Ds						
LAD	509 (88.8)	770 (93.1)	0.005	340 (98.8)	169 (99.4)	0.53
LCX	294 (51.3)	627 (75.8)	<0.001	270 (78.5)	150 (88.2)	0.007
RCA	332 (57.9)	686 (83.0)	<0.001	290 (84.3)	164 (96.5)	<0.001
LM	104 (18.2)	110 (13.3)	0.013	160 (46.5)	72 (42.4)	0.37
Three-VD	124 (21.6)	446 (53.9)	<0.001	236 (68.6)	143 (84.1)	<0.001
Any CTO	91 (15.9)	202 (24.4)	<0.001	157 (45.6)	79 (46.5)	0.86

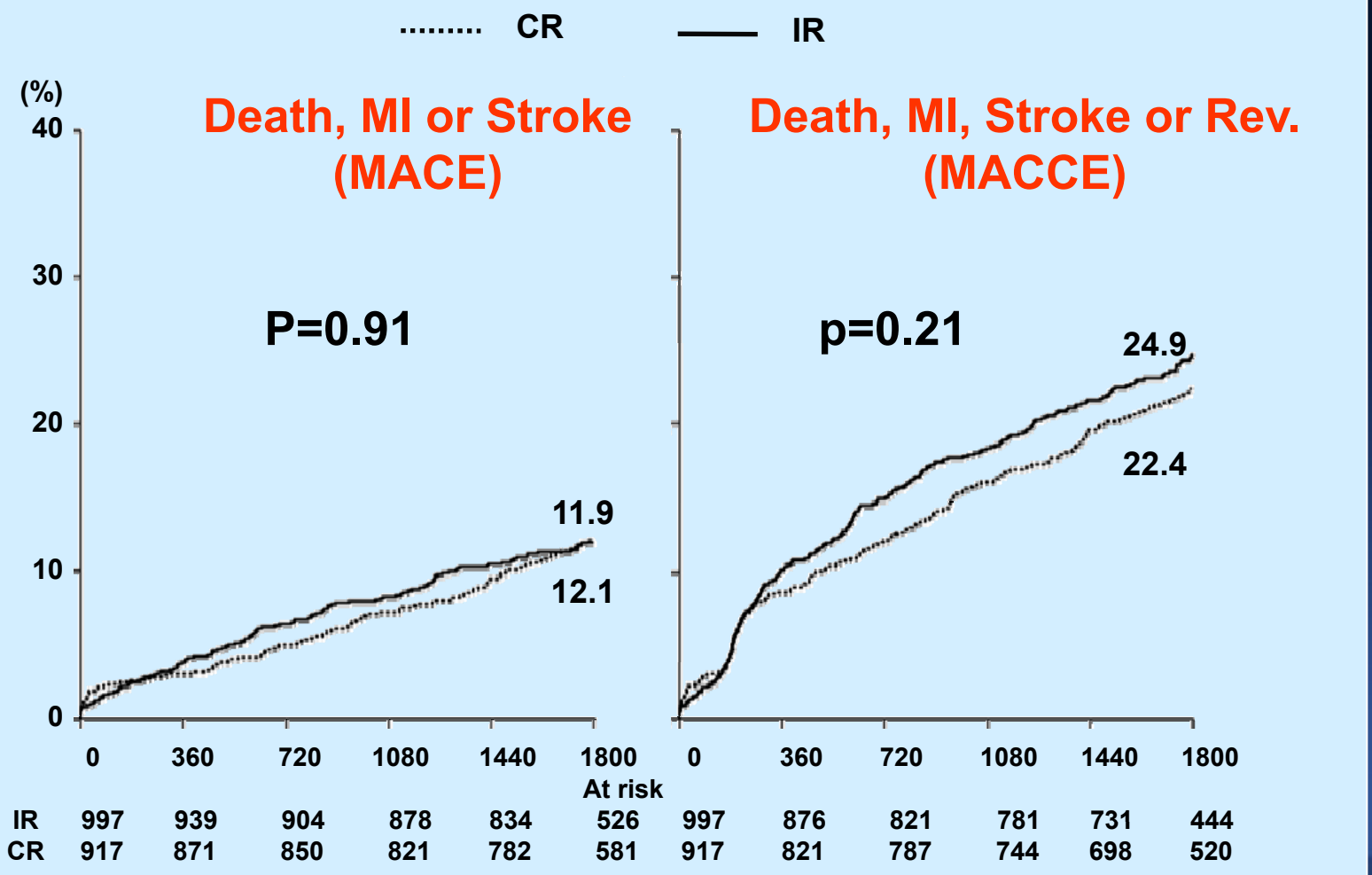
Kim YH et al. Circulation. 2011;123:2373

Procedures

Variable	PCI			CABG		
	CR (N=573)	IR (N=827)	P	CR (N=344)	IR (N=170)	P
CABG procedures						
No. of conduits	–	–	–	3.6±1.0	2.9±1.1	<0.001
No. of a. conduit	–	–	–	1.0±0.1	1.0±0.1	0.58
Internal thoracic a.	–	–	–	266 (77.3)	128 (75.3)	0.61
Off-pump surgery	–	–	–	92 (26.7)	42 (24.7)	0.62
PCI techniques						
No. of total stents	2.5±1.3	2.2±1.2	<0.001	–	–	–
Stents length (mm)	63.6±36.3	55.9±32.3	<0.001	–	–	–
Stent size (mm)	3.2±0.3	3.1±0.3	0.063	–	–	–

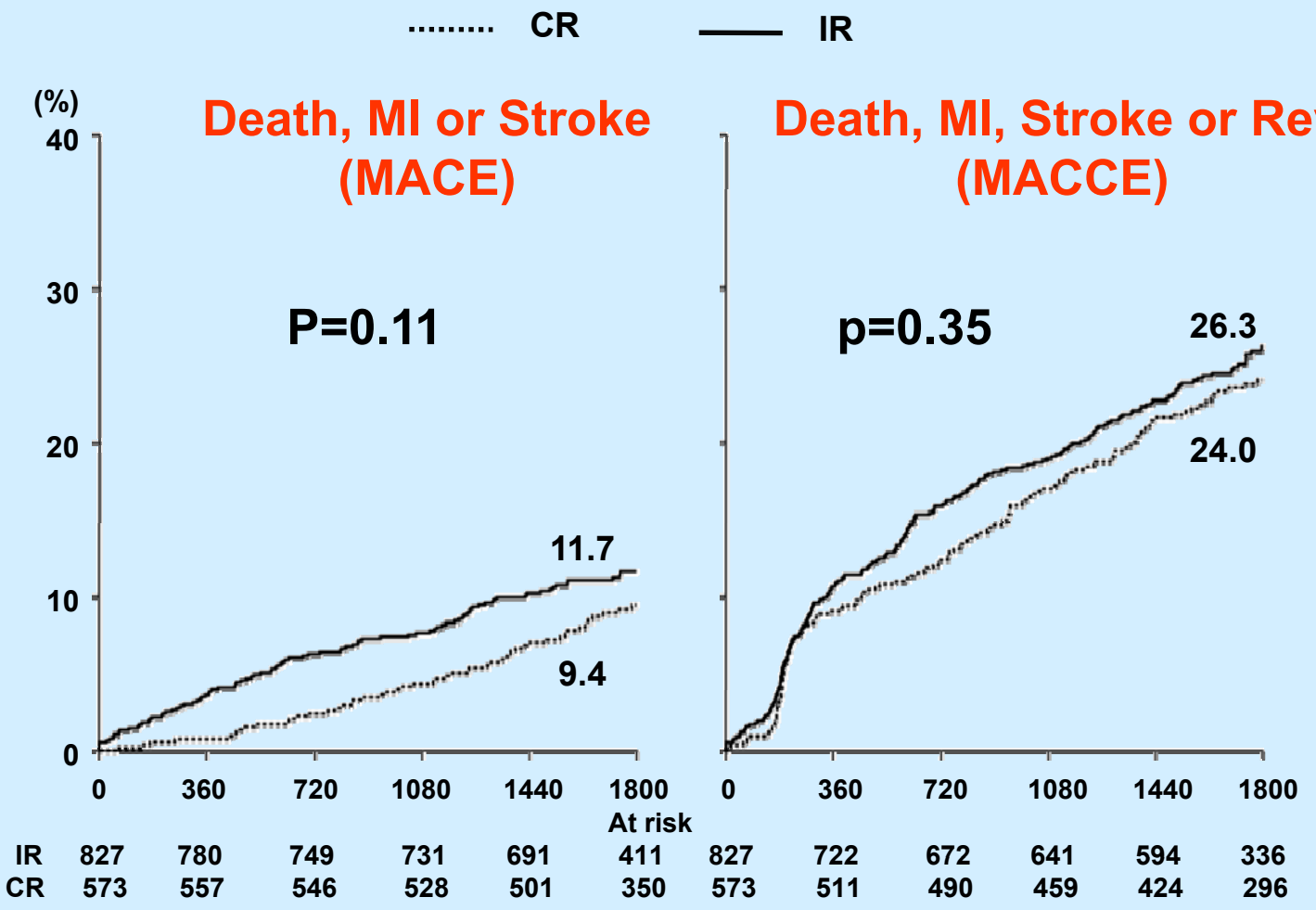
Kim YH et al. Circulation. 2011;123:2373

Unadjusted Outcomes in All Pts
By Angiographic CR-1 (1.5mm)



Kim YH et al. Circulation. 2011;123:2373

Unadjusted Outcomes in PCI Pts
By Angiographic CR-1 (1.5mm)



Kim YH et al. Circulation. 2011;123:2373

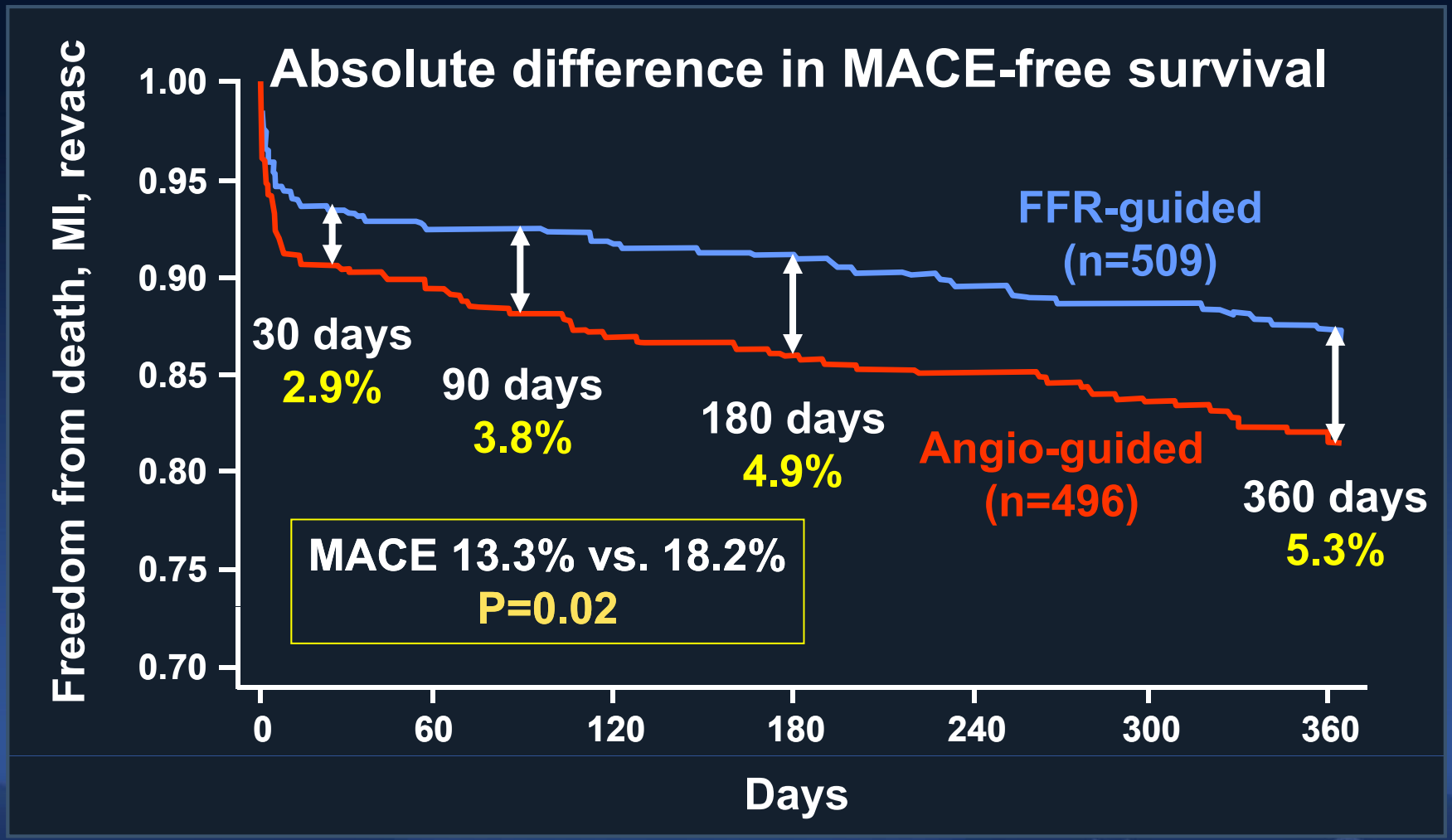
Adjusted Outcomes of MACCE

Definitions	Adjustment using inverse-probability-of-treatment weighting			
	HR	95% CI		p
		LL	UL	
Angiographic CR-1 (≥ 1.5 mm vessel)	0.91	0.75	1.10	0.32
Angiographic CR-2 (≥ 2.5 mm vessel)	0.92	0.76	1.12	0.40
Proximal CR (proximal segment)	0.90	0.74	1.10	0.30

No interaction was found between the treatment type and any definition of CRs.

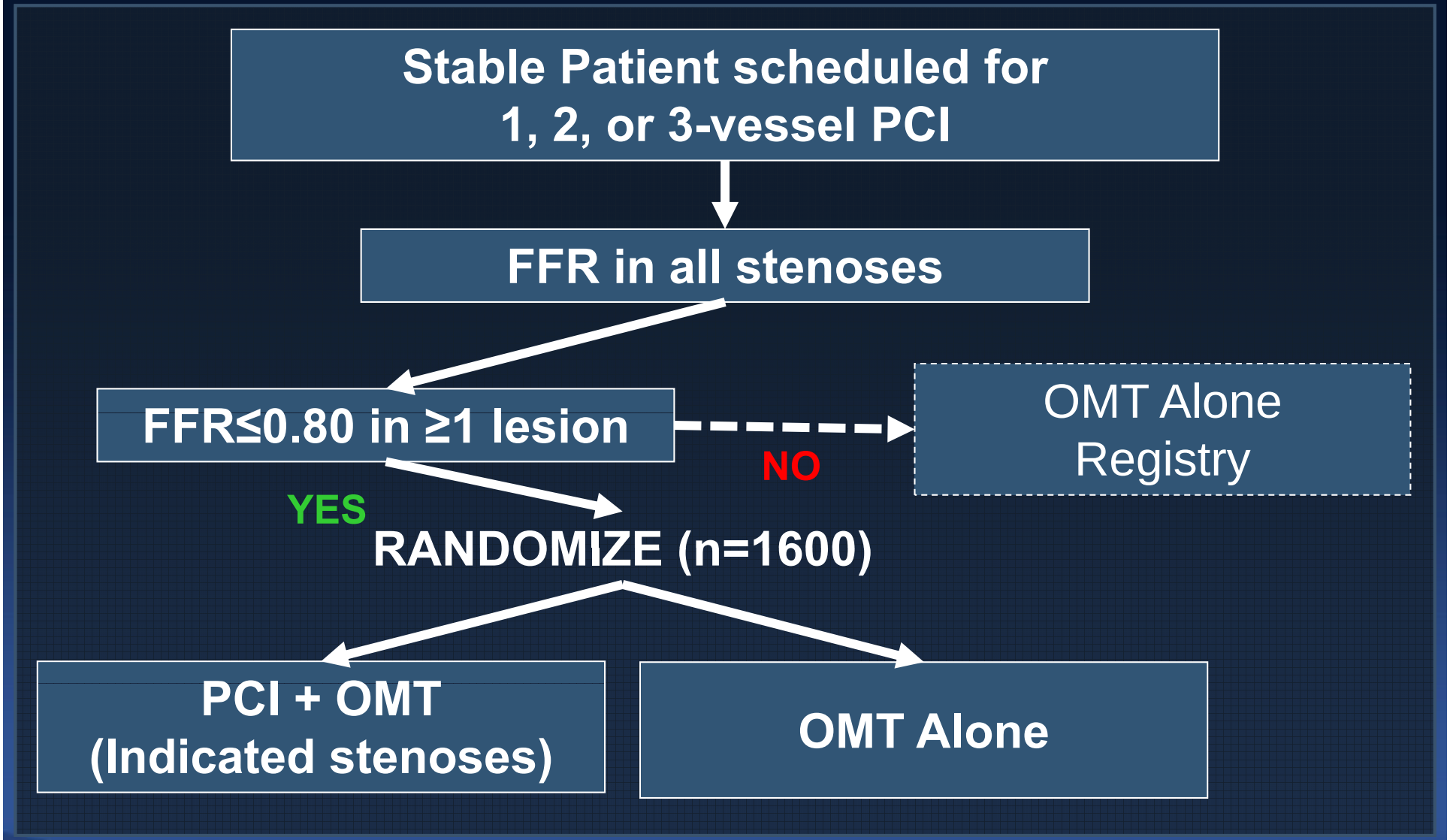
FAME : FFR-guided PCI

1005 pts with MVD undergoing PCI with DES were randomized to FFR-guided vs. angio-guided intervention



Tonino PAL et al. *NEJM* 2009;360:213–24

FAME II : FFR-guided PCI vs. OMT



FFR-guided PCI reduced urgent revascularization than OMT

FFR shows benefit in FAME II; enrollment halted

JANUARY 18, 2012 Lisa Nainggolan

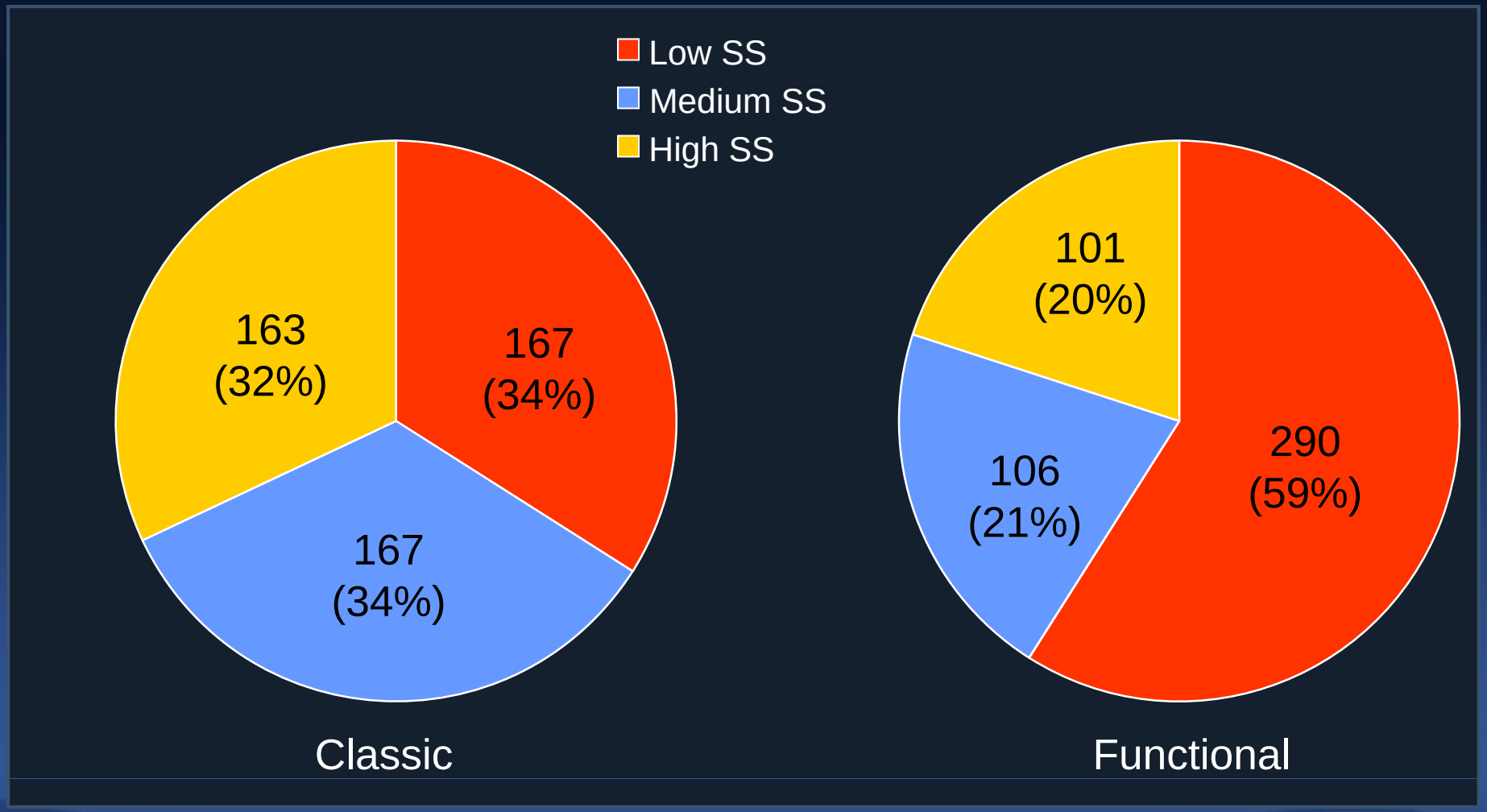
St Paul, MN - An interim analysis of the FAME II study— which is comparing fractional-flow-reserve (FFR)-guided stenting with optimal medical treatment (OMT) compared with OMT alone—has shown a clear benefit of the FFR-guided approach and, as a result, the independent data safety monitoring board (DSMB) has recommended that patient enrollment be stopped [**1**]. "The DSMB considers it unethical to continue to randomize patients to OMT alone," notes St Jude Medical in a statement.

The analysis revealed a statistically significant reduction in the need for hospital readmission and urgent revascularization when FFR-guided assessment was used to direct treatment in patients with coronary artery disease (CAD) in FAME II, it adds.

FFR is a physiological index used to determine the hemodynamic severity of narrowings in the coronary arteries and is measured using St Jude Medical's **PressureWire Aeris** and **PressureWire Certus**. FFR specifically identifies which narrowings are responsible for obstructing the flow of blood to the heart and guides the interventional cardiologist in determining which lesions warrant stenting, "resulting in improved patient outcomes and reduced healthcare costs," the company notes.

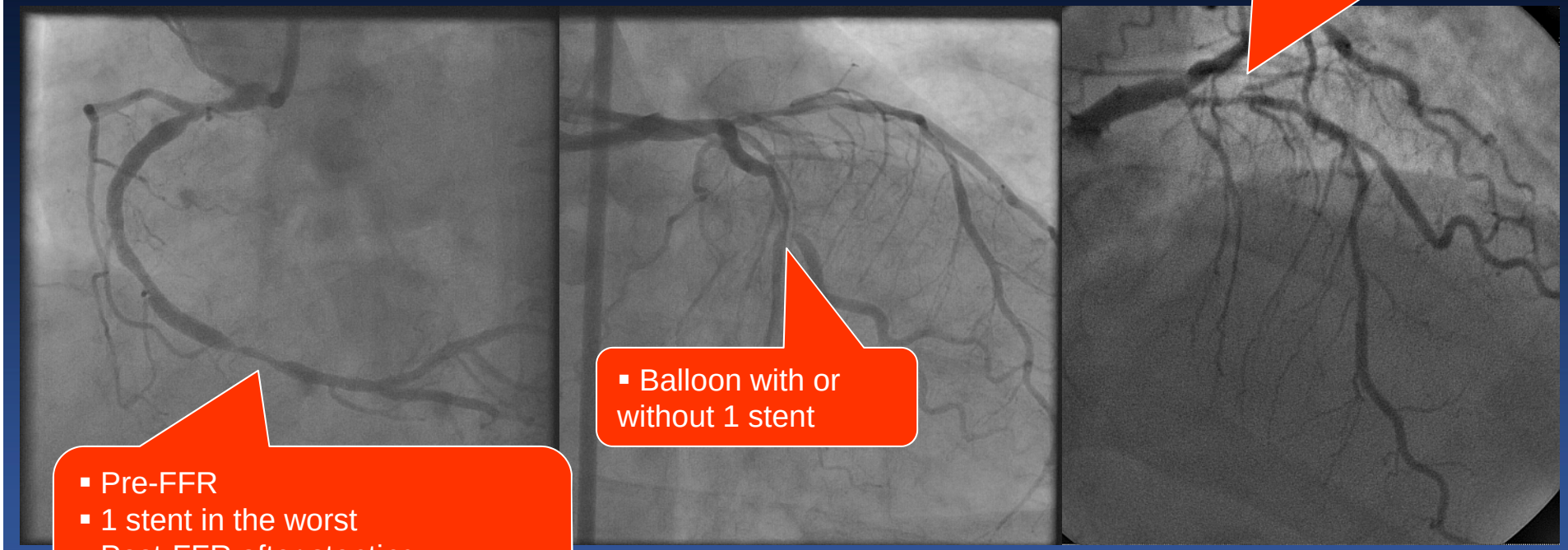
FAME II has randomized 1219 patients with stable CAD in 28 centers in Europe, the US, and Canada; those who are already participating will continue to be followed according to the trial protocol, but no new patients will be enrolled. Currently, there is no difference in the rates of death or MI between the two study arms, says St Jude, noting that initial results from the trial will be presented this year.

Anatomical CR is not necessary for a good outcome of PCI !



Nam et al, JACC 2011;58:1211-18

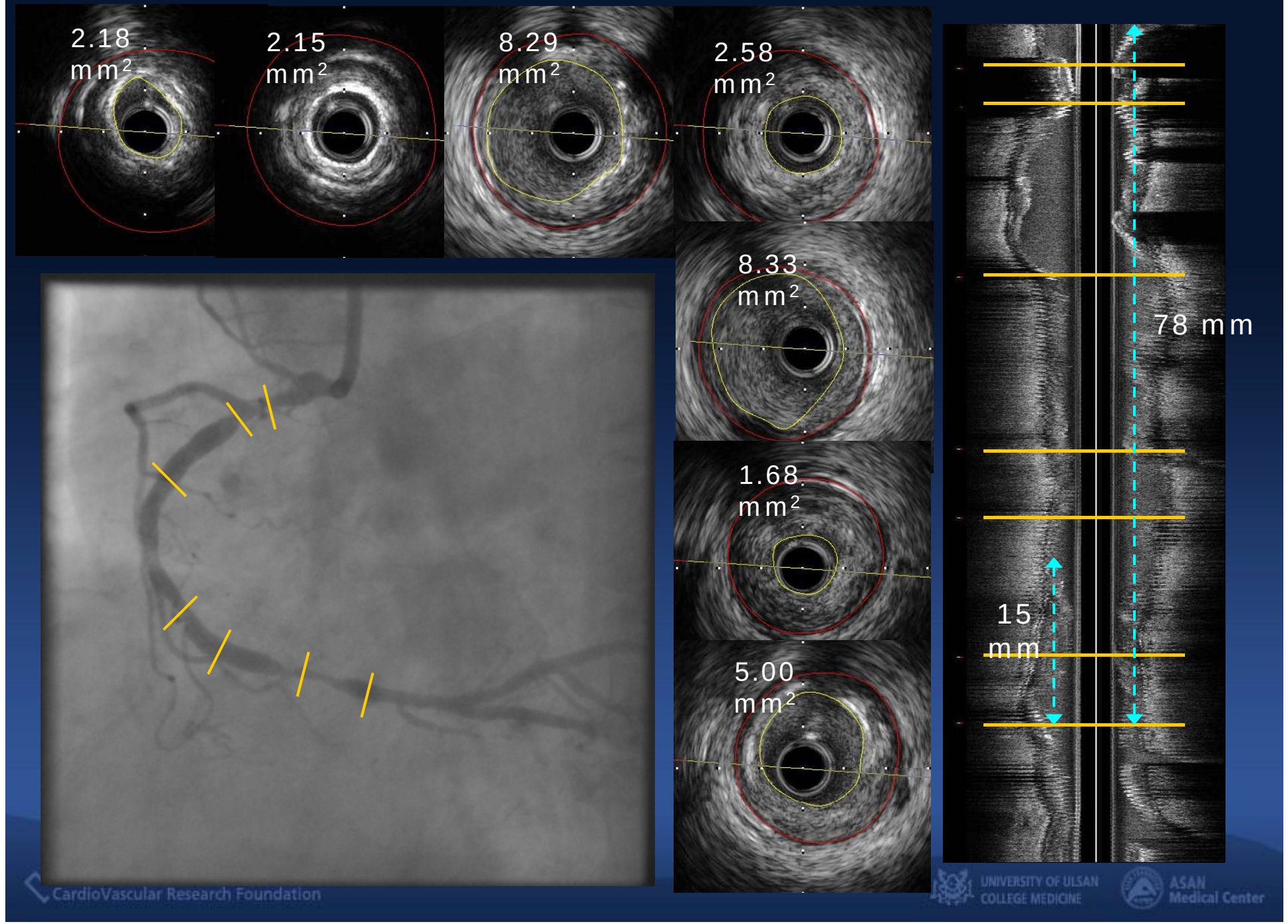
Function-guided Reasonable Incomplete Revascularization



- Pre-FFR
- 1 stent in the worst
- Post-FFR after stenting
- 1 stent in other LAD if p-FFR ≤ 0.75

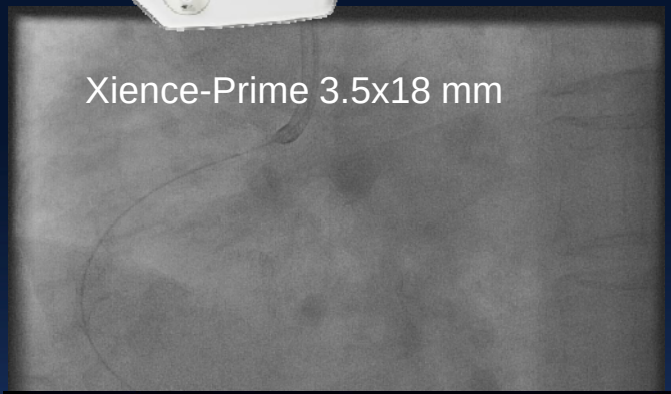
- Balloon with or without 1 stent

- Pre-FFR
- 1 stent in the worst
- Post-FFR after stenting
- 1 stent in pRCA if p-FFR ≤ 0.75

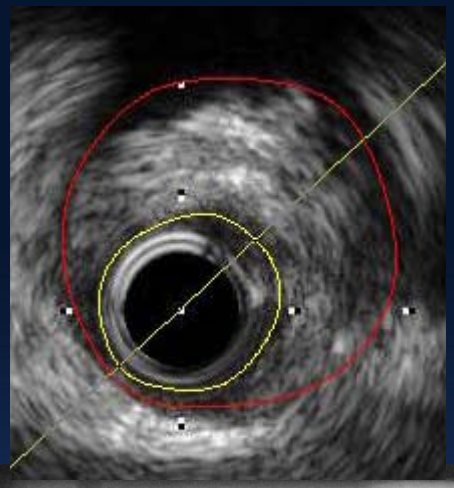

2.18 mm²
2.15 mm²
8.29 mm²
2.58 mm²
8.33 mm²
1.68 mm²
5.00 mm²
78 mm
15 mm
CardioVascular Research Foundation
UNIVERSITY OF ULSAN COLLEGE MEDICINE
ASAN Medical Center

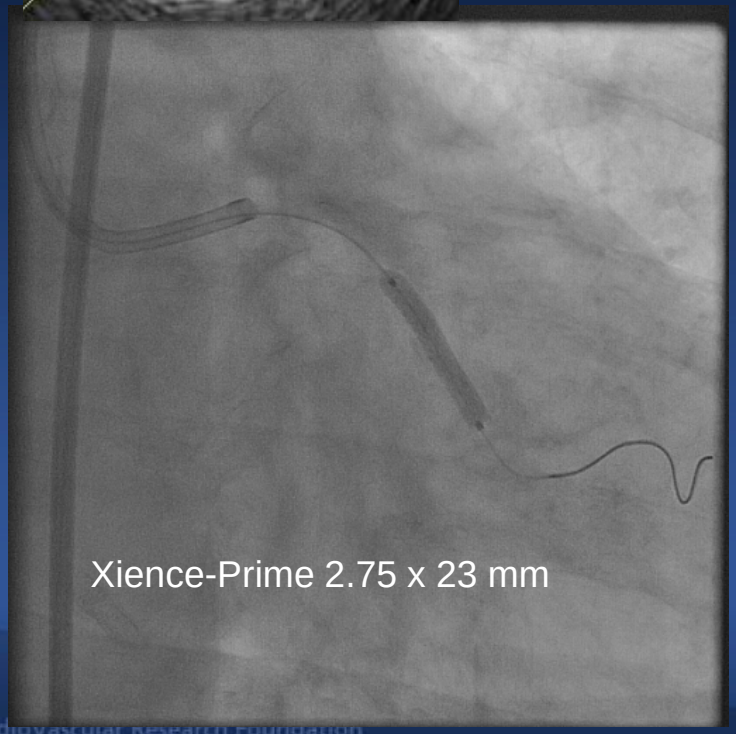
RCA Intervention

Pre-FFR 0.72 in dRCA

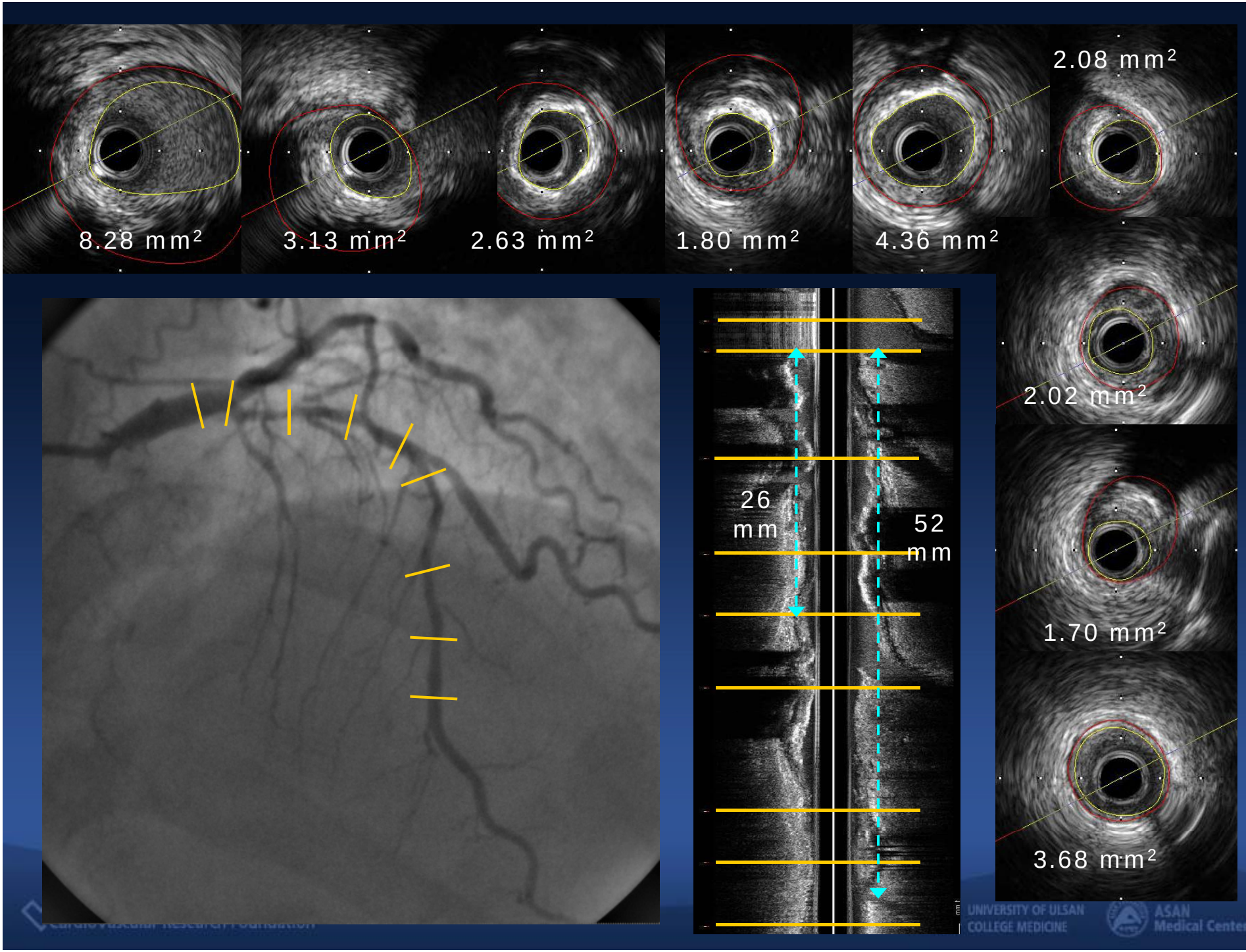


IVUS and LCX Stenting without FFR





Xience-Prime 2.75 x 23 mm


8.28 mm²
3.13 mm²
2.63 mm²
1.80 mm²
4.36 mm²
2.08 mm²
2.02 mm²
1.70 mm²
3.68 mm²
26 mm
52 mm
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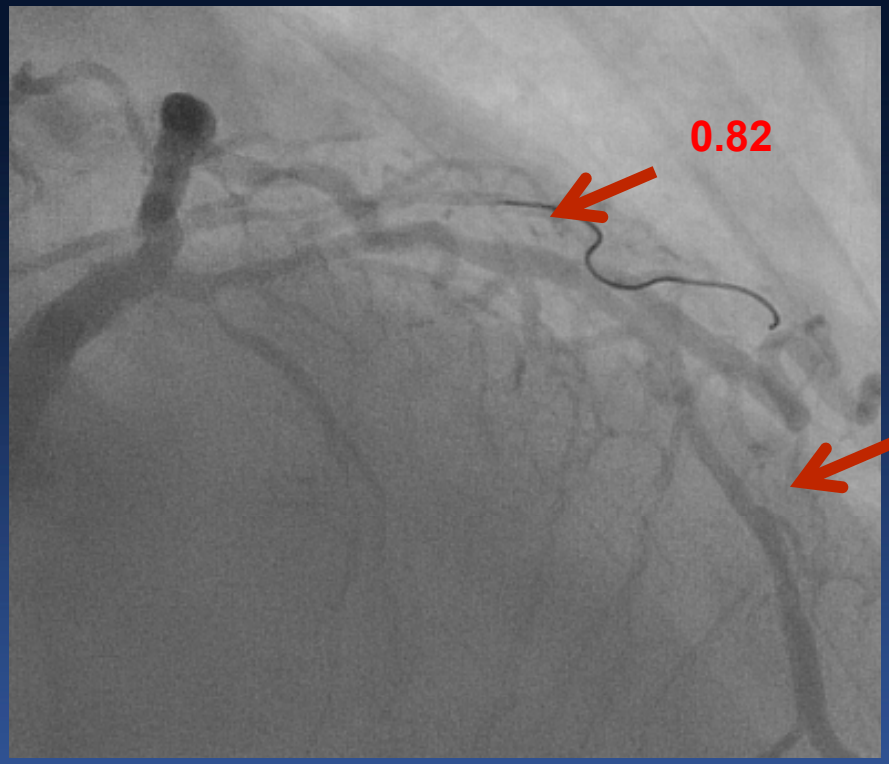
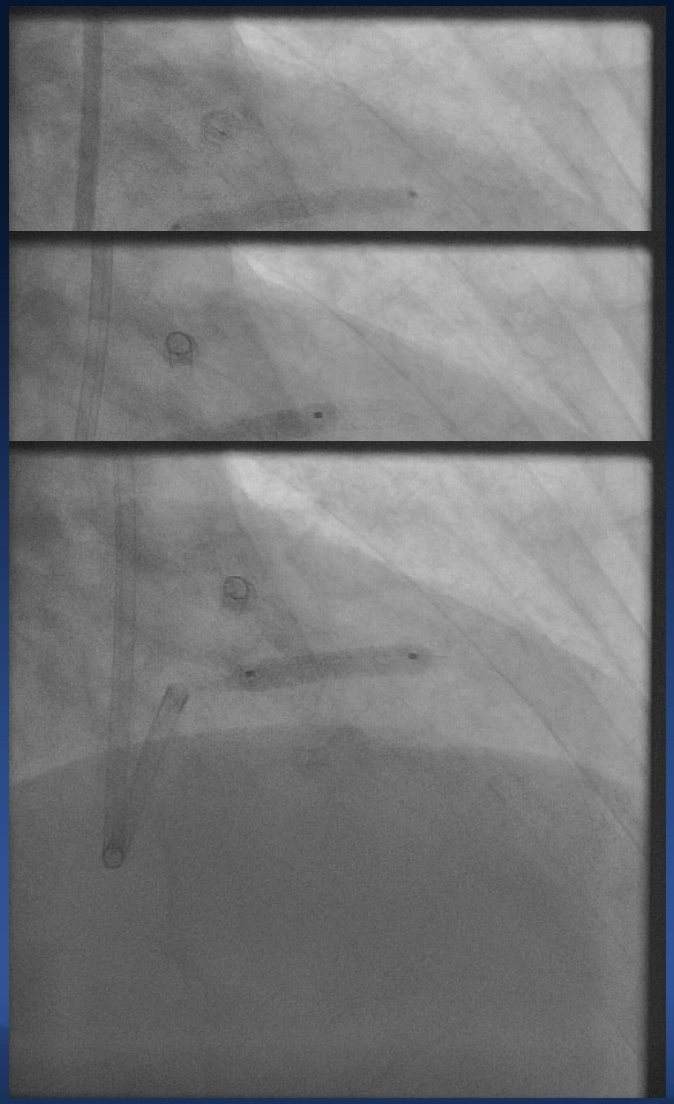
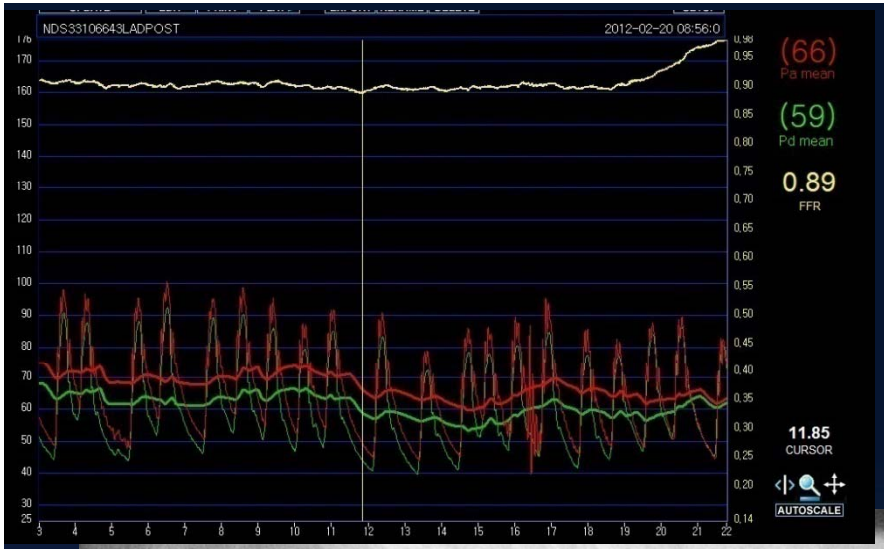
LAD Intervention with FFR



Stenting followed by NC



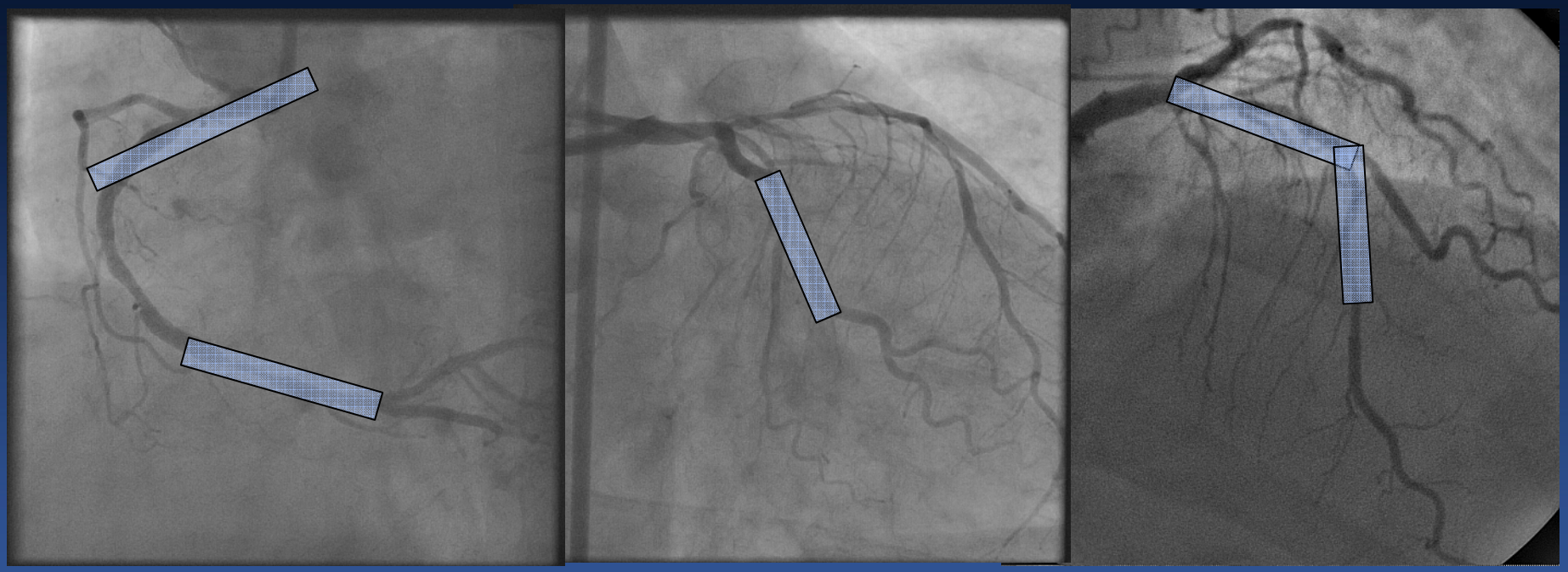

NDS33106643LADPOST
2012-02-20 08:56:0
(66)
Pa mean
(59)
Pd mean
0.89
FFR
11.85
CURSOR
AUTOSCALE

Post-FFR

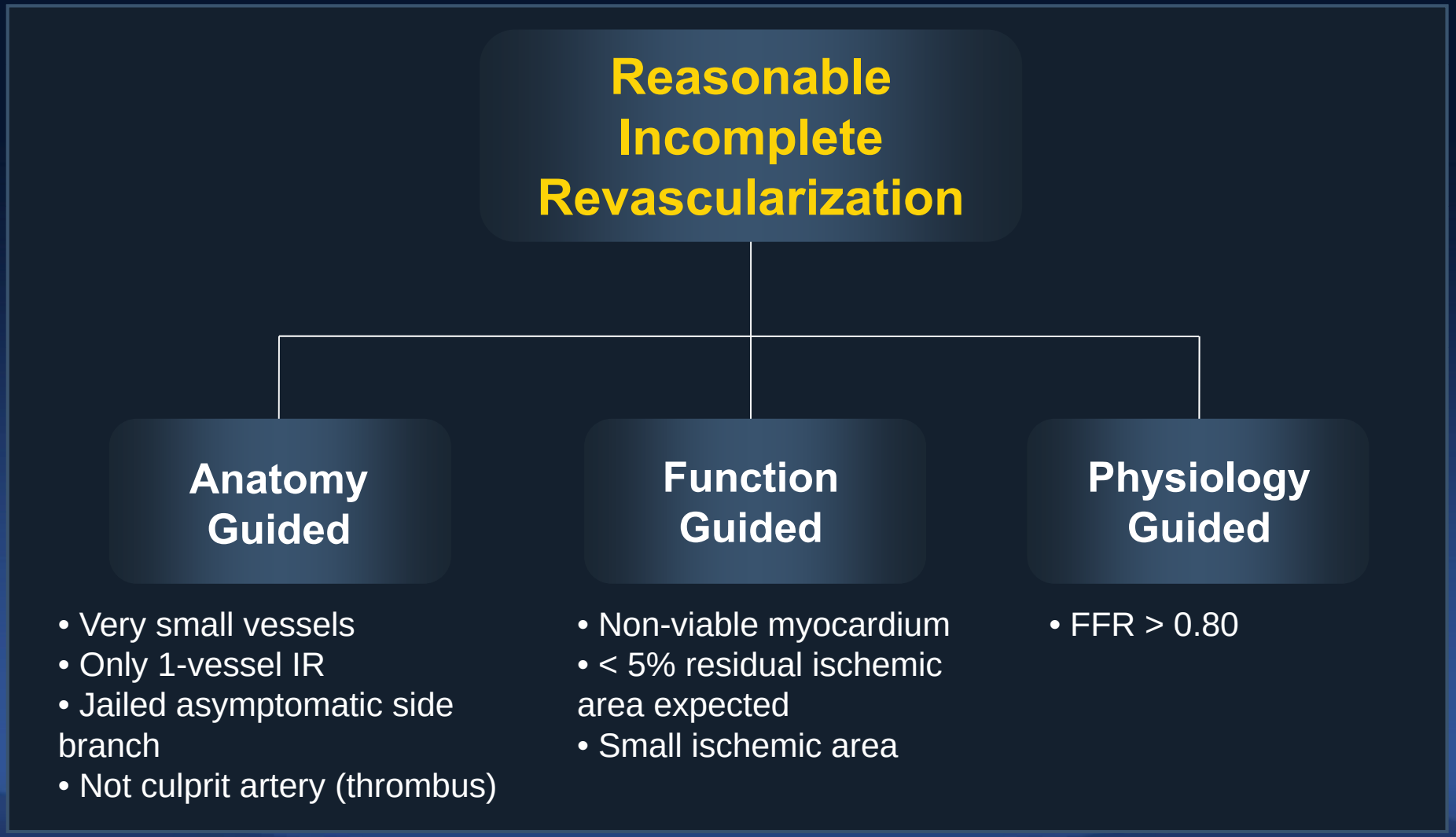
Function-guided PCI

Reasonable Incomplete Revascularization

using 3 stents



What is a reasonable incomplete revascularization ?



Dauerman HL. Circulation. 2011;123:2337