

Ischemia-Guided Revascularization for Stable Angina Patients

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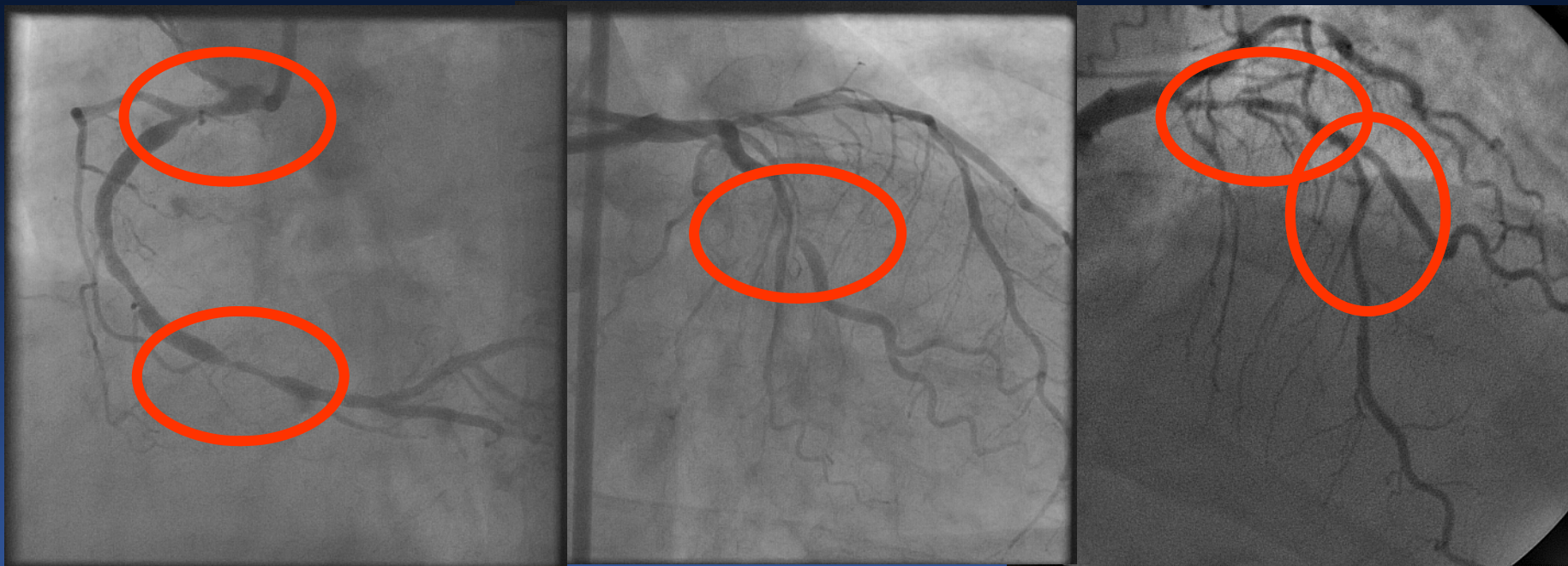
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Multivessel (Multilesion) CAD

- 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

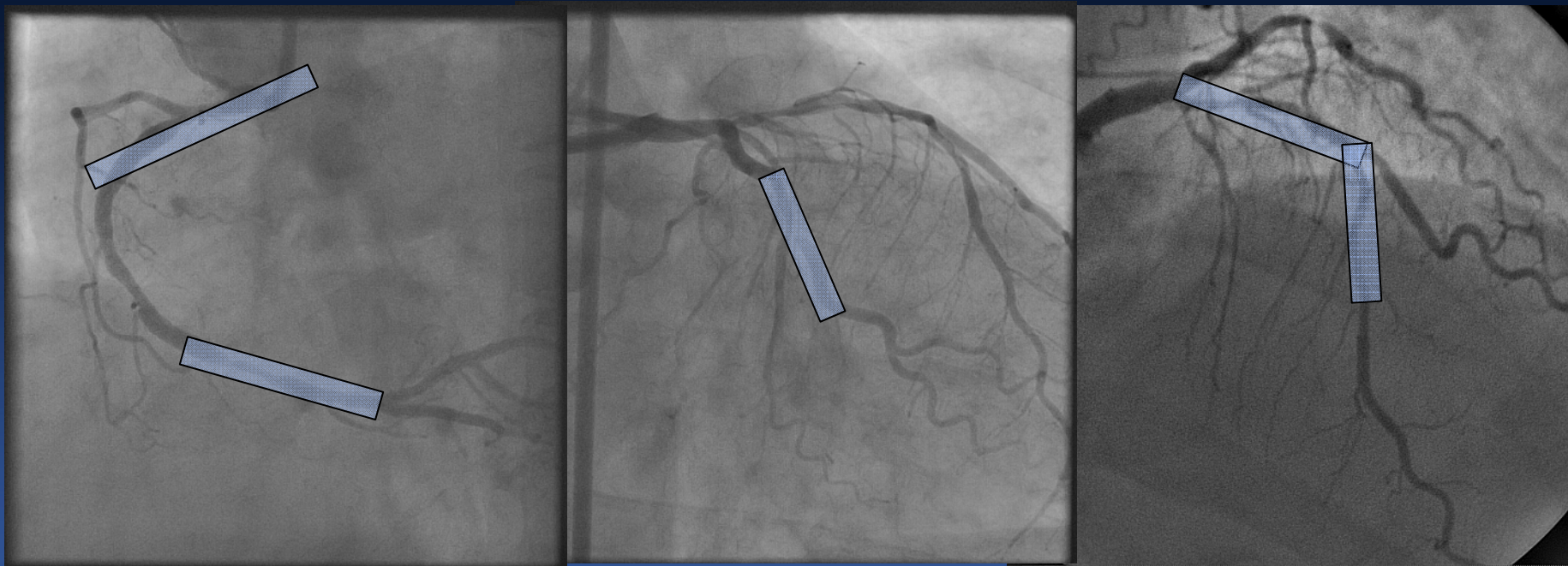
Stable Angina (M/72, normal EF)

SYNTAX Calculation = 24



Simulation

Complete Revascularization using at least 5 stents

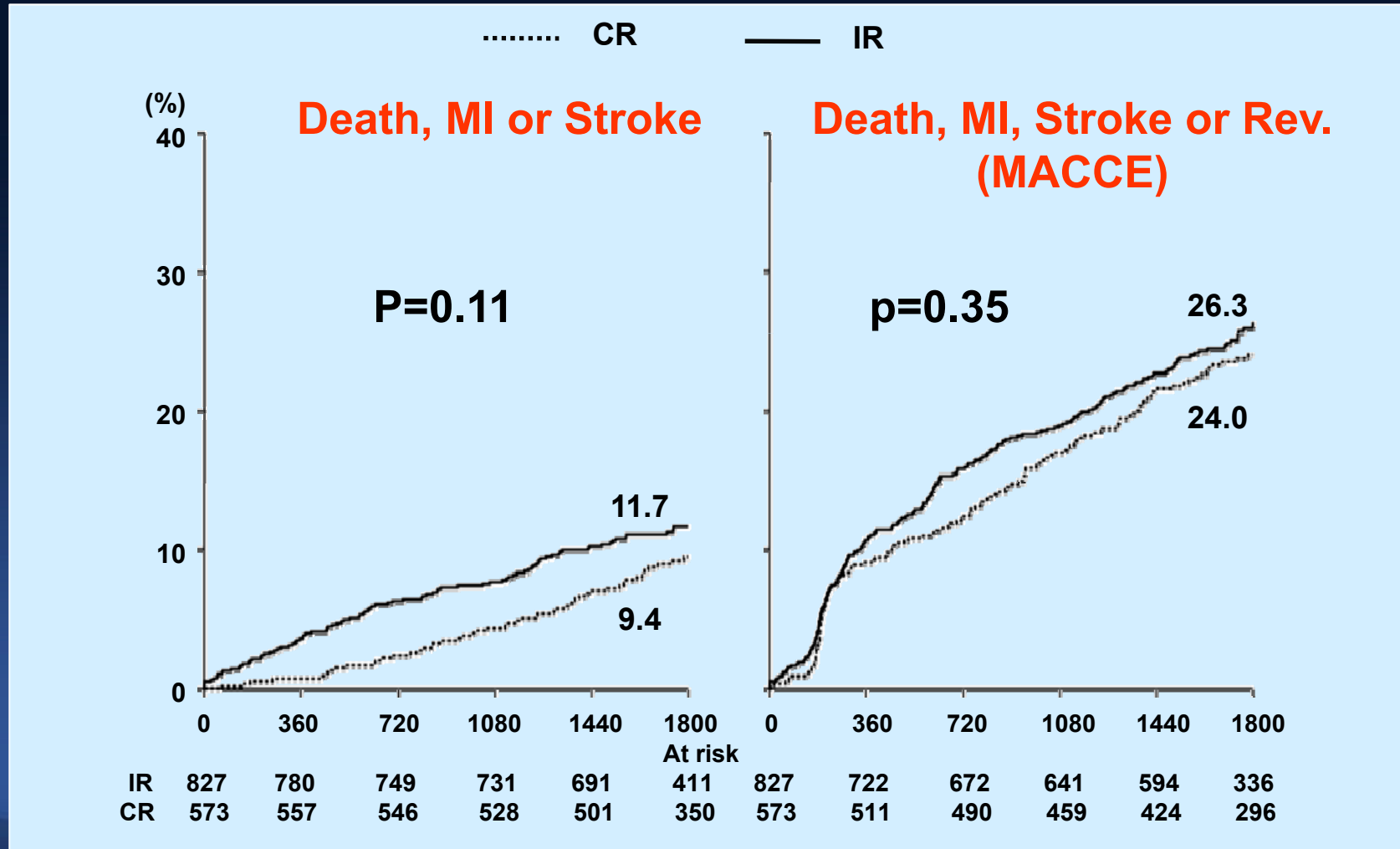


ESC 2011 and ACC 2011 Update PCI vs. CABG

Subset of CAD by anatomy	<< CABG		<< PCI	
	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

Angiographic CR improves prognosis?

1914 Angina MVD (1400 PCI, 514 CABG) in Asan Multivessel Registry



Adjusted Outcomes of MACCE

Adjustment using inverse-probability-of-treatment weighting

Definitions

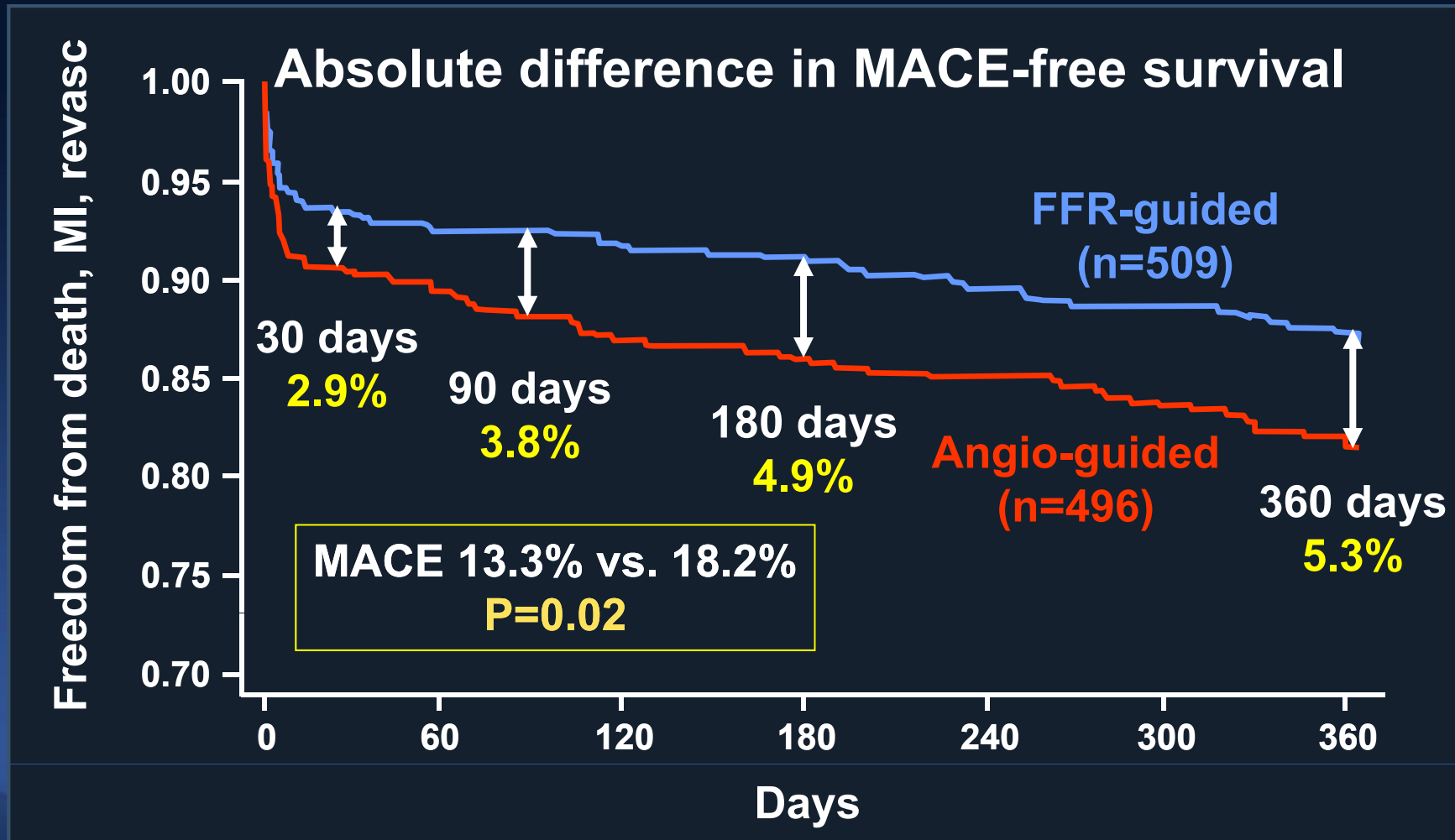
	HR	95% CI		p
		LL	UL	
Angiographic CR-1 (≥ 1.5 mm vessel)	0.91	0.75	1.10	0.32
Angiographic CR-2 (≥ 2.5 mm vessel)	0.92	0.76	1.12	0.40
Proximal CR (proximal segment)	0.90	0.74	1.10	0.30

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

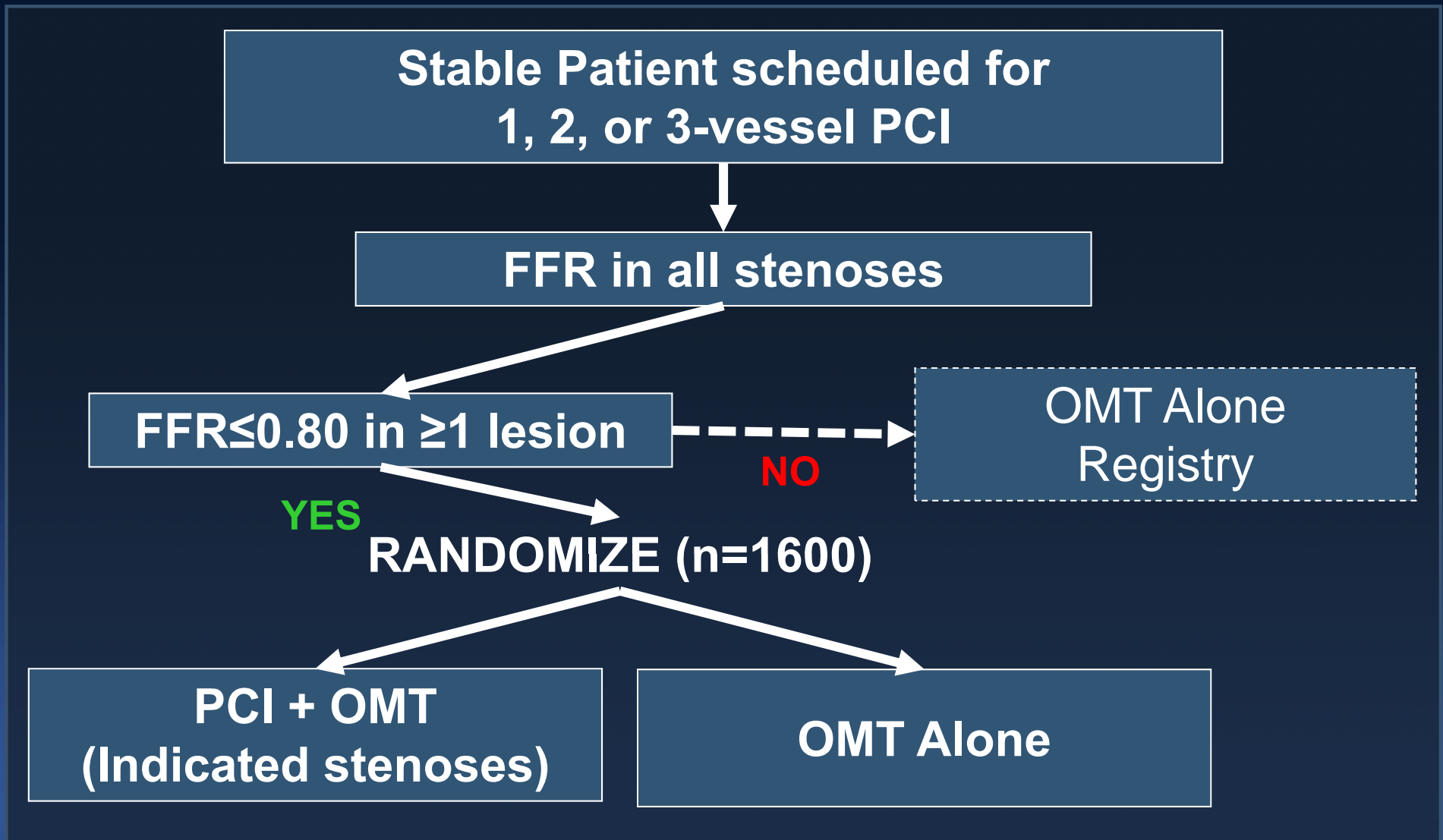
FAME : FFR-guided PCI



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



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

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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.

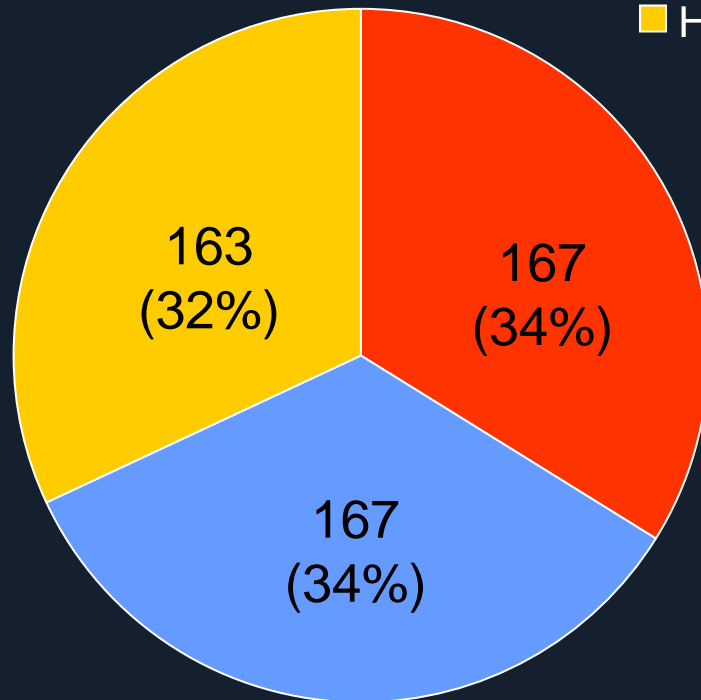
FFR is a physiological index used to determine the hemodynamic severity of narrowings in the coronary arteries and is measured using St Jude Medical's **PressureWire Aeris** and **PressureWire Certus**. FFR specifically identifies which narrowings are responsible for obstructing the flow of blood to 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.

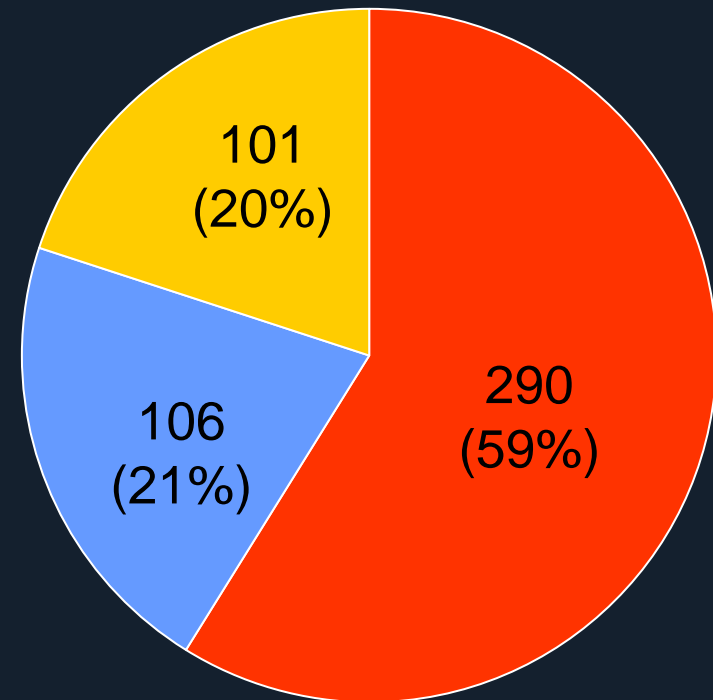


Anatomical PCI is not necessary for a good outcome of PCI !

■ Low SS
■ Medium SS
■ High SS



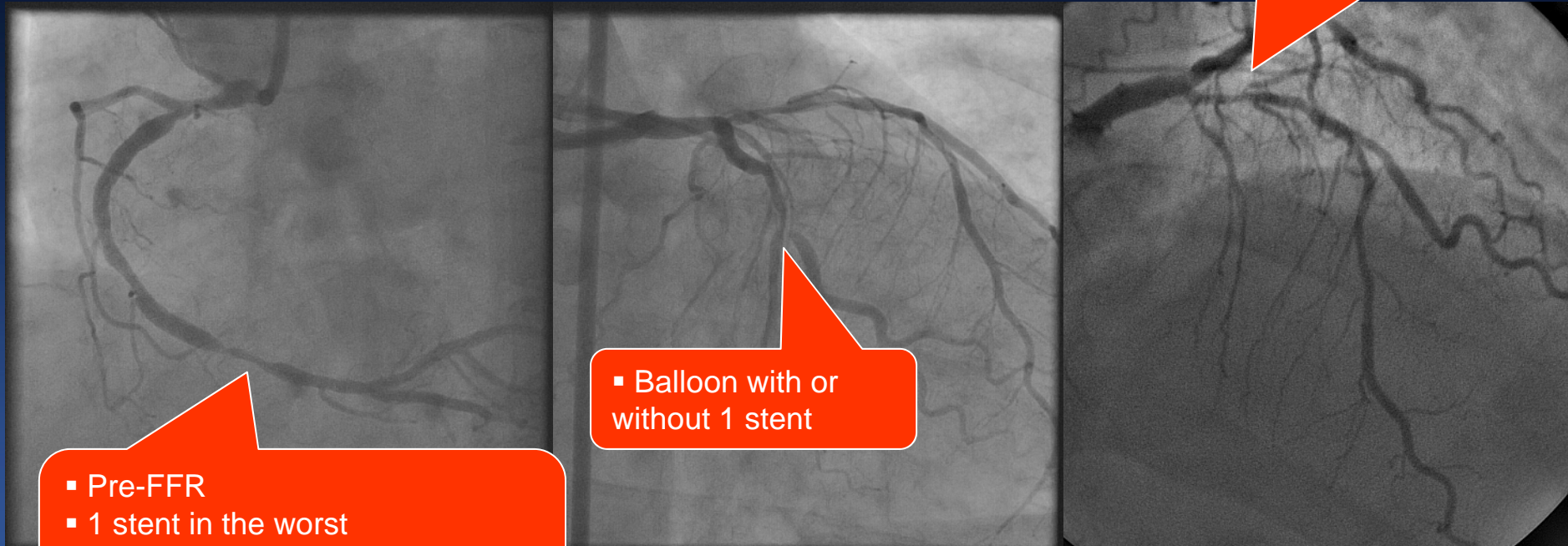
Classic



Functional

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

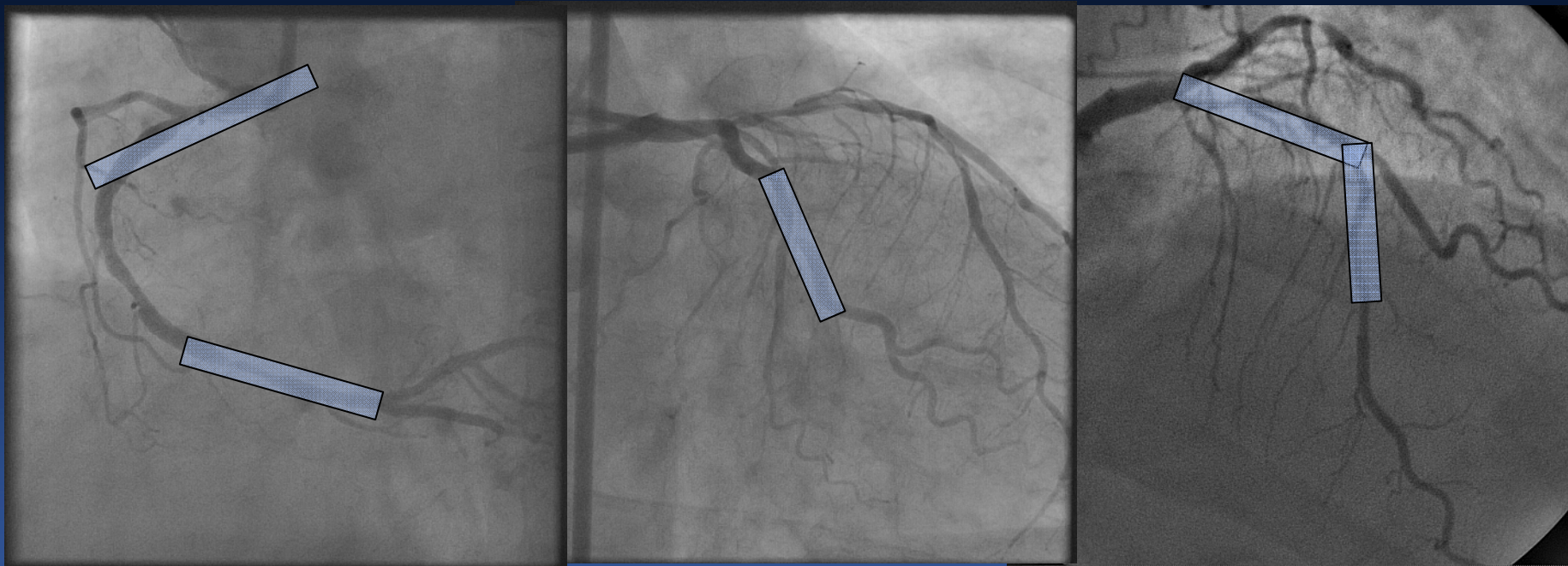


- Pre-FFR
- 1 stent in the worst
- Post-FFR after stenting
- 1 stent in pRCA if p-FFR ≤ 0.75

- Balloon with or without 1 stent

Function-guided PCI

Reasonable Incomplete Revascularization using 3 stents



ESC 2011 Update

Indications of Revascularization

	Subset of CAD by anatomy	Class	Level
For prognosis	Left main >50% *	I	A
	Any proximal LAD >50% *	I	A
	2VD or 3VD with impaired LV function *	I	B
	Proven large area of ischemia (> 10%LV)	I	B
	Single remaining patent vessel >50% stenosis *	I	C
	1VD without proximal LAD and without >10% ischemia	III	A
For symptoms	Any stenosis >50% with limiting angina or angina equivalent, unresponsive to OMT	I	A
	Dyspnea/CHF and >10%LV ischemia/viability supplied by >50% stenotic artery	IIa	B
	No limiting symptoms with OMT	III	C

* With documented ischemia or FFR < 0.8

Reasonable Incomplete Revascularization

Editorial

Reasonable Incomplete Revascularization

Harold L. Dauerman, MD

Incomplete coronary artery revascularization could increase the risk of death, myocardial infarction, repeat revascularization, and lifestyle-limiting angina. Data to support this hypothesis extend back to the early 1980s, when patients with incomplete surgical revascularization had an absolute 15% reduction in 5-year survival in comparison with patients with complete revascularization.^{1,2} This hypothesis should extend to percutaneous coronary intervention (PCI). Two New York State registry analyses demonstrated an increased risk of death associated with incomplete stent-based revascularization, and the Arterial Revascularization Therapies Study (ARTS) trial described a greater need for subsequent bypass surgery after incomplete stent revascularization.³⁻⁵ One study has linked incomplete stent-based revascularization with impaired improvement in left ventricular function, and thus suggests a mechanism for increased mortality risk.⁶

Article see p 2373

Despite the pejorative reputation of incomplete revascularization, the findings of Kim et al⁷ from the Asan Medical Center Multivessel Register in the current issue of *Circulation*

more common clinical discussions of stentable and graftable vessels; namely, incomplete revascularization is commonly defined as any nonrevascularized vessel with >1.5-mm diameter and 50% to 100% stenosis.^{3,8} Other registry studies have used a more stringent stenosis requirement of >70% severity.⁴ The current registry analyzed the frequency of incomplete revascularization in multiple ways, including using the 1.5-mm diameter/50% to 100% definition (overall incidence, 52%) and a 2.5-mm diameter/50% to 100% stenosis definition (overall incidence, 41%). Other registry definitions provide estimates of stent-based incomplete revascularization as high as 69% of patients with multivessel disease.⁴

Incomplete revascularization occurs more frequently in PCI patients, but it is not rare in CABG populations—in the current study, incomplete revascularization occurred in 33% of CABG patients in comparison with 59% of PCI patients ($P<0.001$). Although the practice of incomplete revascularization by traditional definition is common, it is also variable. In the New York State registry study, incomplete revascularization with drug-eluting stents ranged from 45% to 89% of

What is a reasonable incomplete revascularization ?

Reasonable Incomplete Revascularization

Anatomy Guided

- Very small vessels
- Only 1-vessel IR
- Jailed asymptomatic side branch
- Not culprit artery (thrombus)

Function Guided

- Non-viable myocardium
- < 5% residual ischemic area expected
- Small ischemic area

Physiology Guided

- FFR > 0.80

Impact of SPECT-based ischemia-guided revascularization

- To evaluate the prognostic impact of ischemia-guided (IG) revascularization using MPI in patients with MVD who underwent PCI with DES or CABG surgery in AMC.

YH Kim et al. J Am Coll Cardiol 2012 (in print)

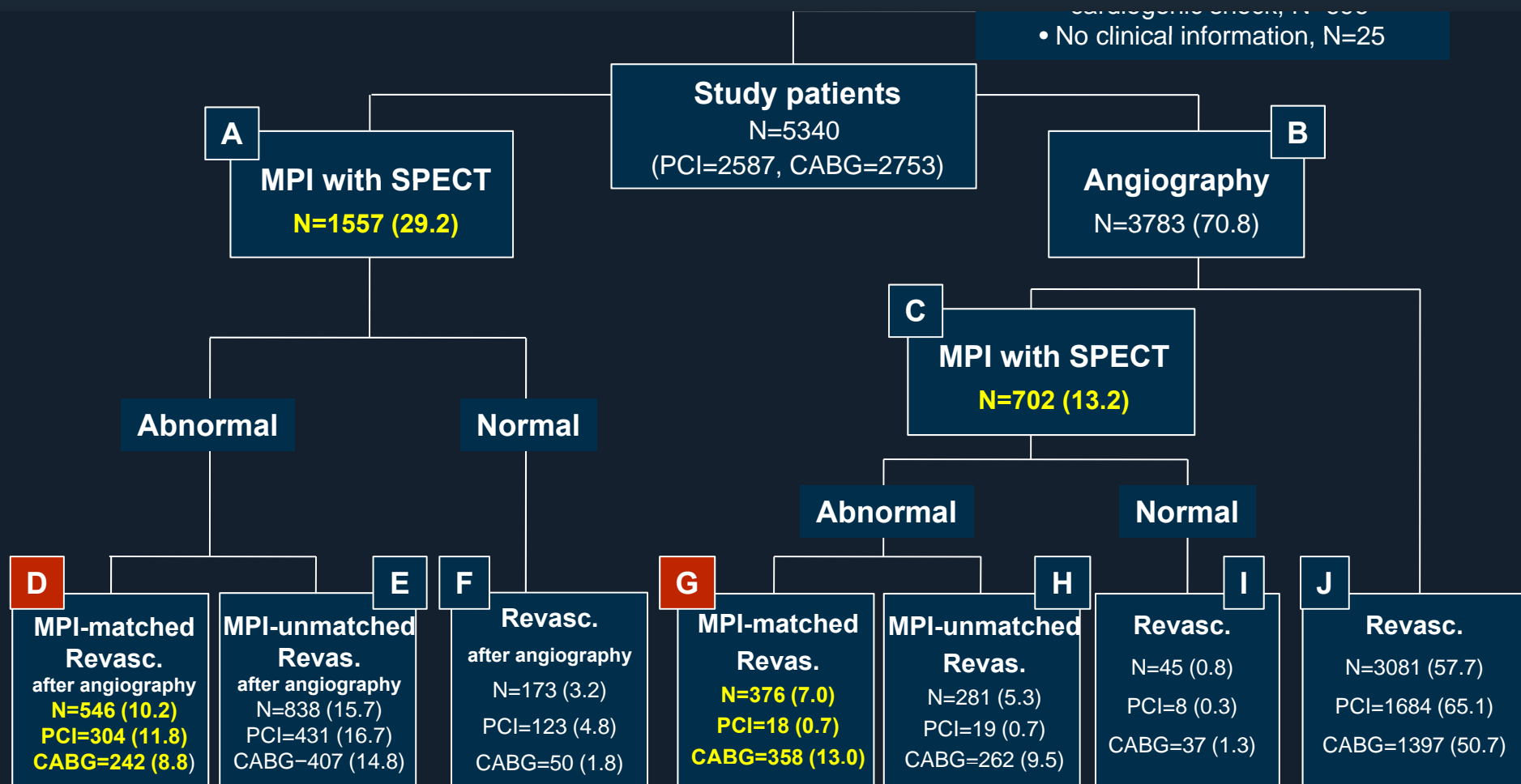
Patients and Procedures

- The study population was a part of the **Asan Multivessel Registry** and included consecutive patients with MVD who underwent PCI with DES or CABG.
- **TI-201 SPECT** was the default stress MPI during the study period (2003 to 2006).
- FFR was rarely performed in the study period.

Definition of IG according to MPI

- **Ischemia-guided (IG) revascularization**
 - Revascularization a LAD and/or non-LAD artery matched with the perfusion abnormalities of MPI during the index hospitalization or within 30 days after the index procedure.
- **Non-IG revascularization**
 - Revascularization for non-ischemic vessels
 - Non-revascularization for ischemic vessels
 - Angiography-guided revascularization without MPI

922 (17.3%) comprising **322 (12.4%)** in the **PCI** and **600 (21.8%)** in the **CABG** ($P<.001$) patients underwent SPECT-guided IG revascularization.



Angiographic Characteristics

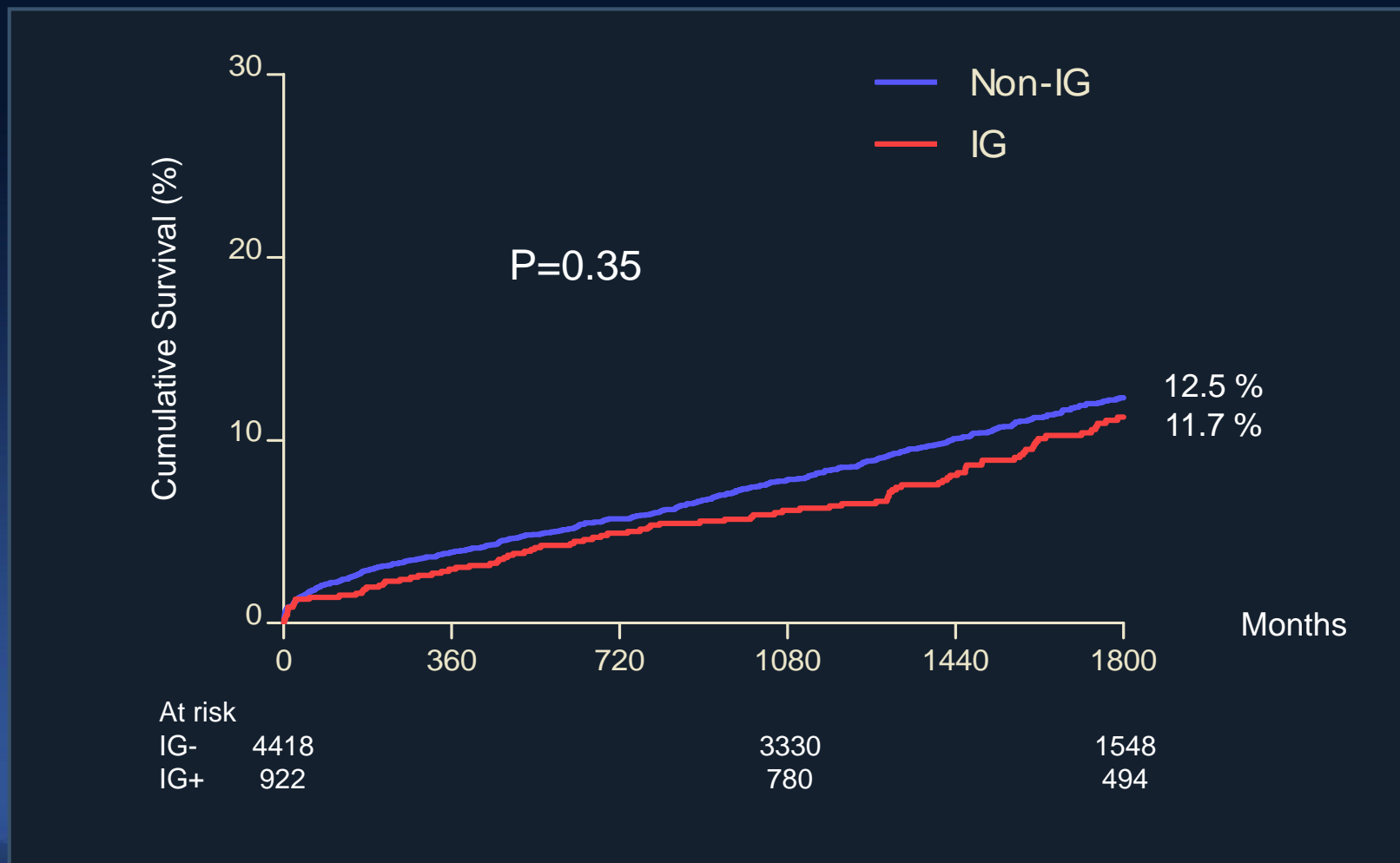
	PCI			CABG		
	IG	Non-IG	<i>P</i>	IG	Non-IG	<i>P</i>
	N=310	N=1713		N=268	N=1061	
SYNTAX score, median	15.5	17.0	0.30	24.5	23.0	0.016
Angiographic stenosis						
LAD artery	260 (83.9)	1555 (90.8)	<0.001	214 (79.9)	854 (80.5)	0.81
Left circumflex artery	202 (65.2)	1106 (64.6)	0.84	160 (59.7)	679 (64.0)	0.19
Right coronary artery	229 (73.9)	1252 (73.1)	0.78	190 (70.9)	746 (70.3)	0.85
Left main	34 (11.0)	261 (15.2)	0.050	95 (35.4)	327 (30.8)	0.15
Three-vessel disease	127 (41.0)	714 (41.7)	0.82	147 (54.9)	604 (56.9)	0.54
Any total occlusion	61 (19.7)	247 (14.4)	0.018	98 (36.6)	283 (26.7)	0.001

Procedures

	PCI			CABG		
	IG N=322	Non-IG N=2265	P	IG N=600	Non-IG N=2153	P
Treadmill test	113 (35.1)	431 (19.0)	<0.001	99 (16.5)	251 (11.7)	0.002
Treated vessel						
LAD or left main artery	205 (63.7)	1768 (78.1)	<0.001	589 (98.2)	2091 (97.1)	0.16
Left circumflex artery	113 (35.1)	940 (41.5)	0.029	477 (79.5)	1680 (78.0)	0.44
Right coronary artery	138 (42.9)	1172 (51.7)	0.003	439 (73.2)	1427 (66.3)	0.001
Conduits, median	—	—	—	3.0 (3.0, 4.0)	3.0 (2.0, 4.0)	<0.001
Arterial conduit, median	—	—	—	3.0 (2.0, 3.0)	2.0 (1.0, 3.0)	<0.001
Internal thoracic artery	—	—	—	510 (85.0)	1867 (86.7)	0.28
Off-pump surgery	—	—	—	370 (61.7)	1243 (57.7)	0.084
Total stents, median	2.0 (1.0, 3.0)	2.0 (2.0, 3.0)	<0.001	—	—	—

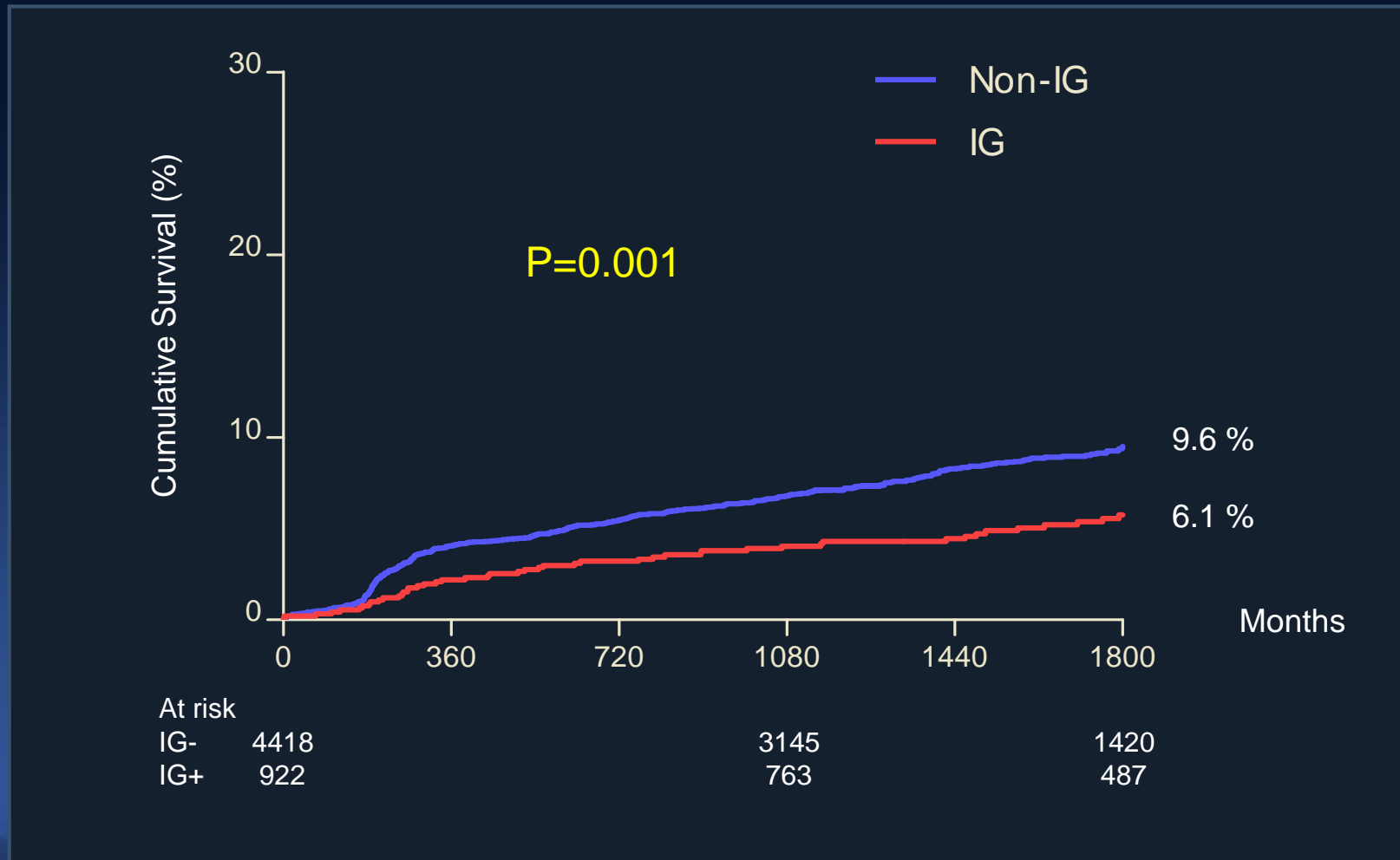
All Patients

Death, MI, or Stroke for 5 Years



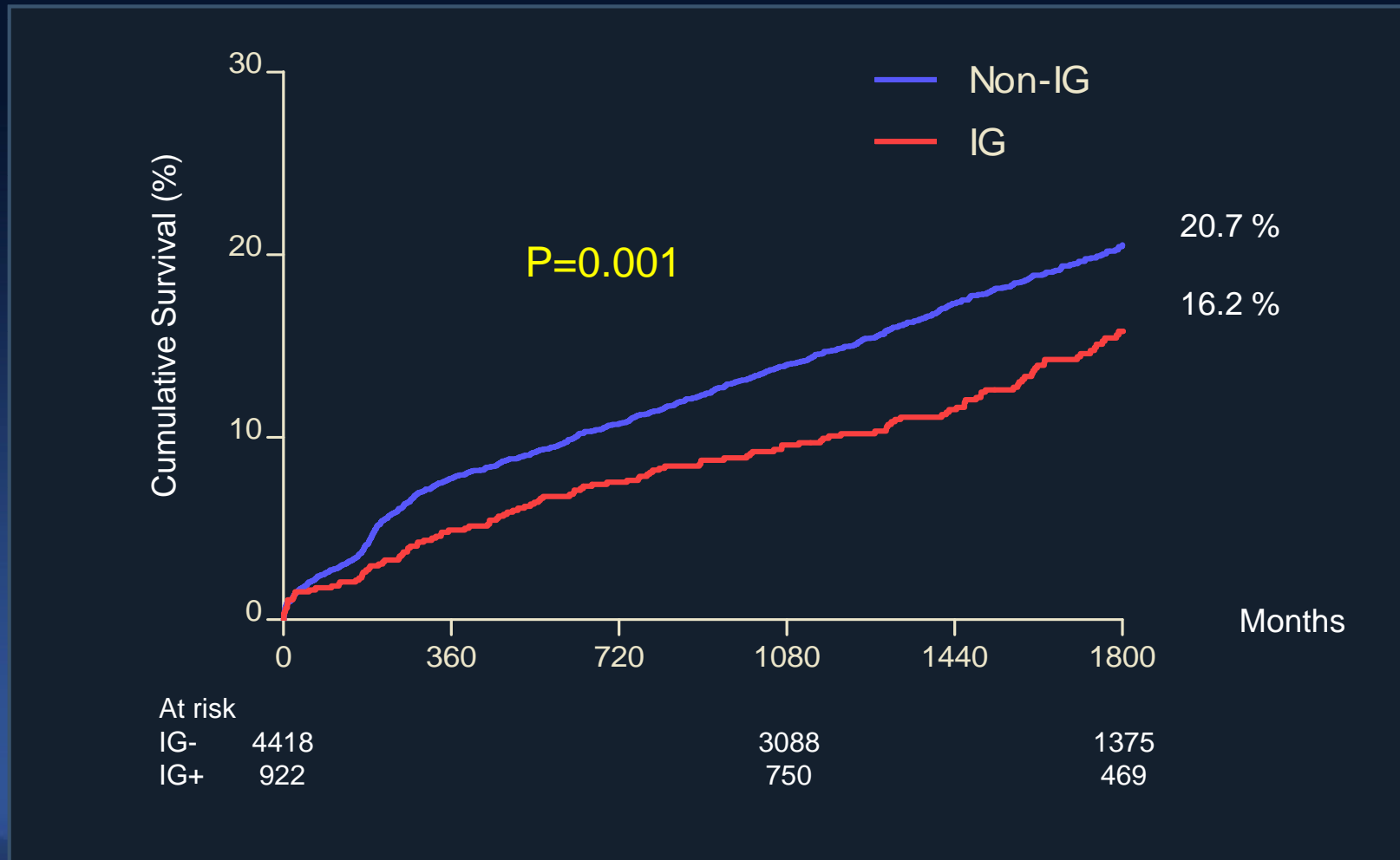
All Patients

Repeat Revascularization for 5 Years



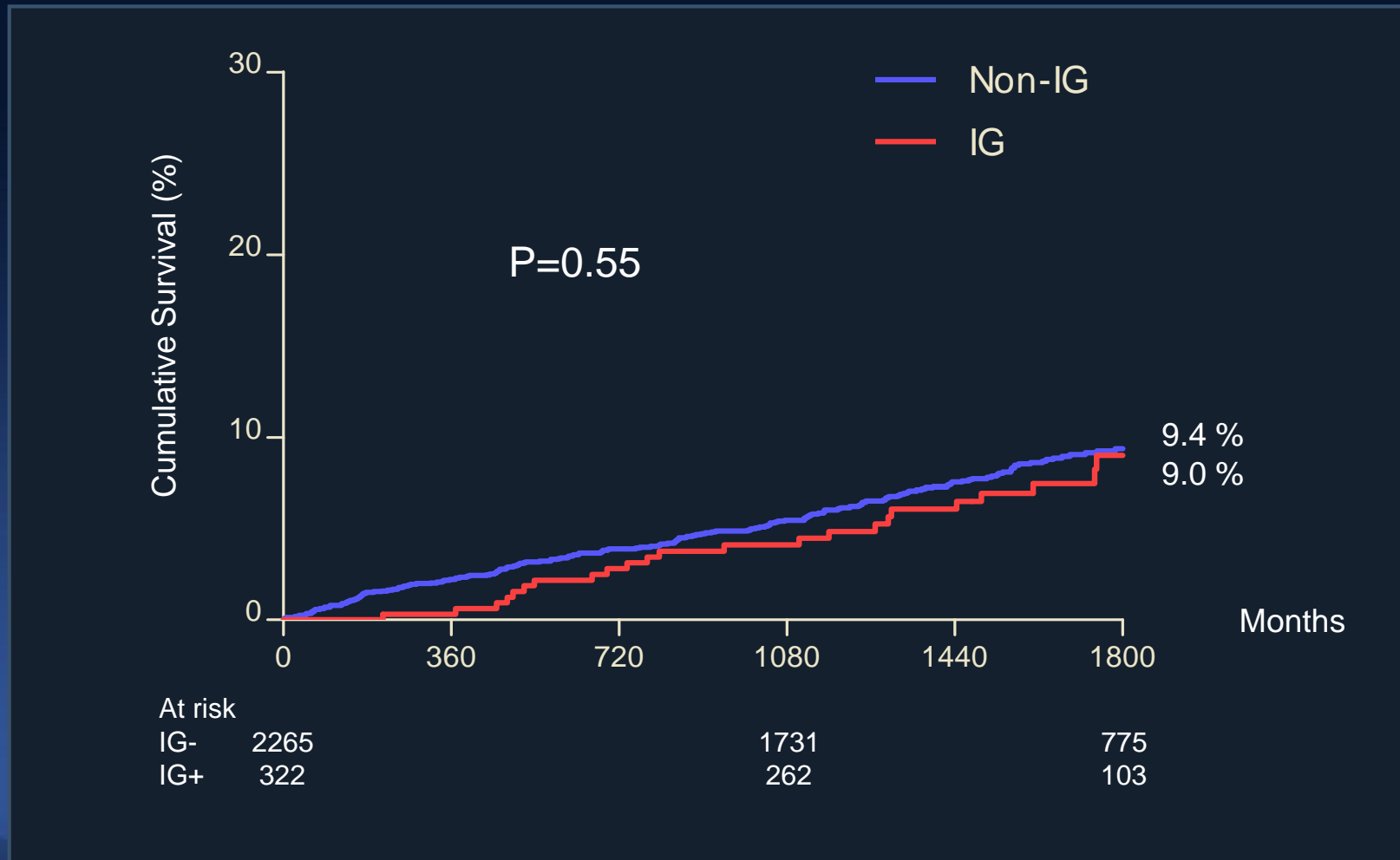
All Patients

MACCE for 5 Years



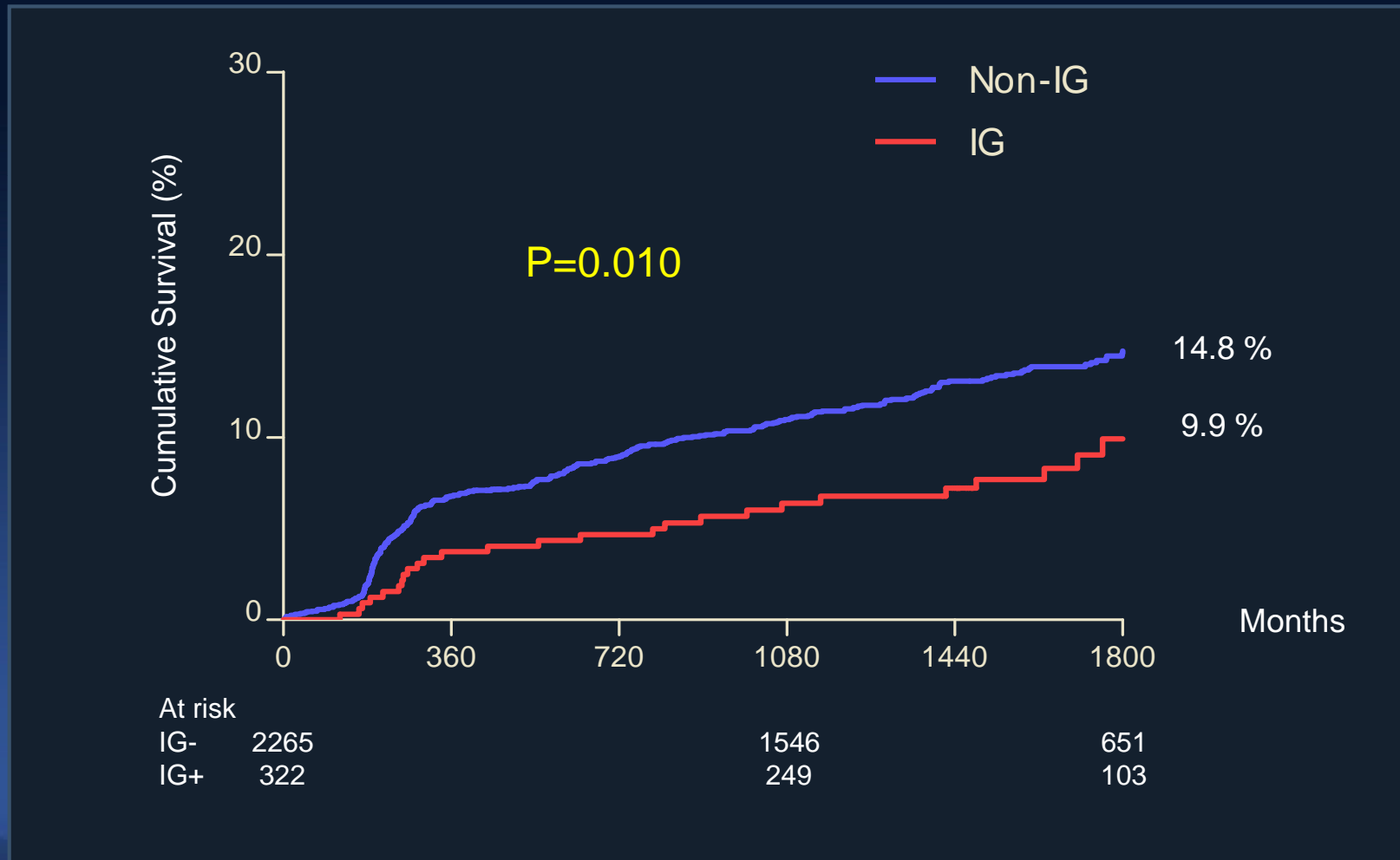
PCI Patients

Death, MI, or Stroke for 5 Years



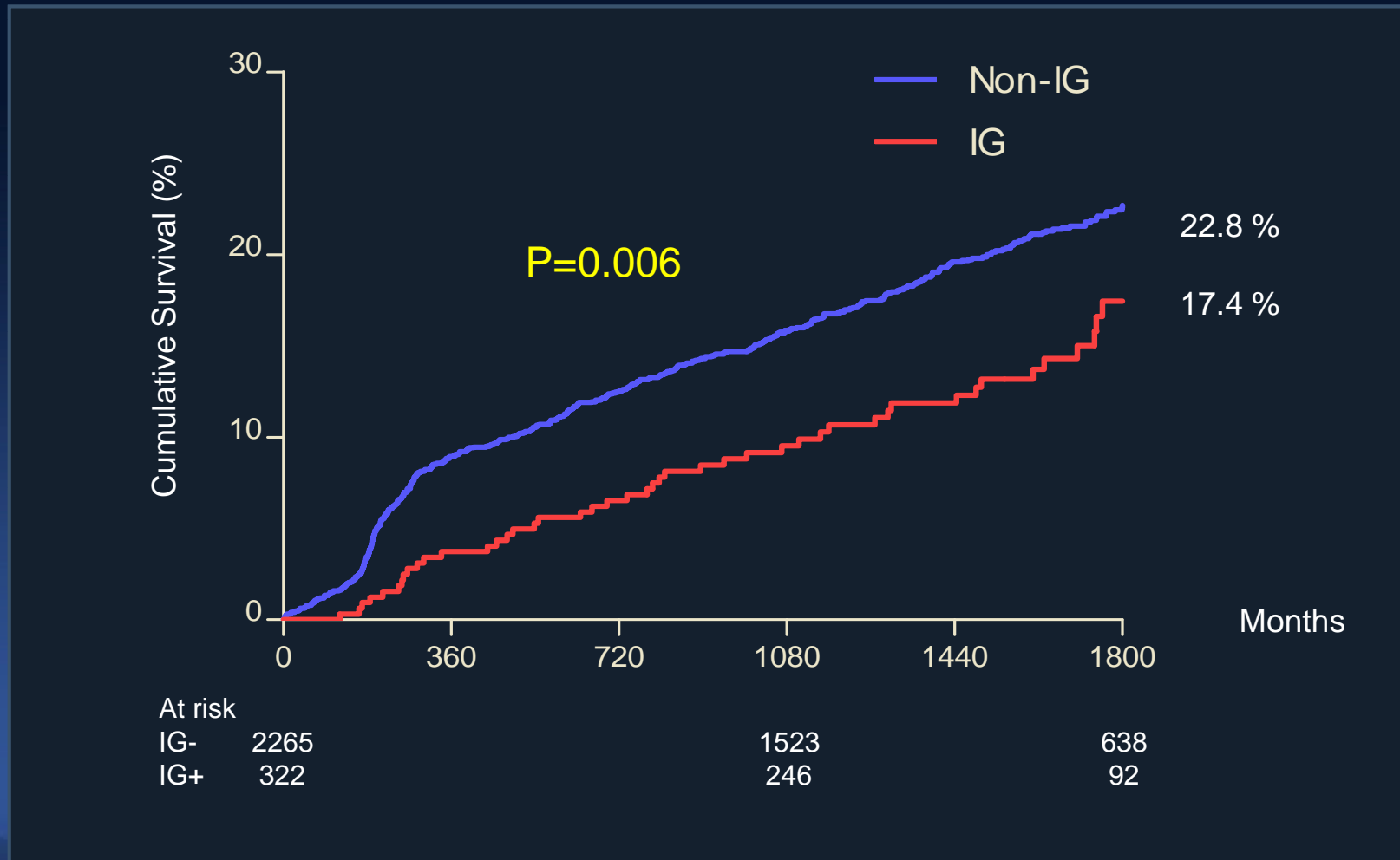
PCI Patients

Repeat Revascularization for 5 Years



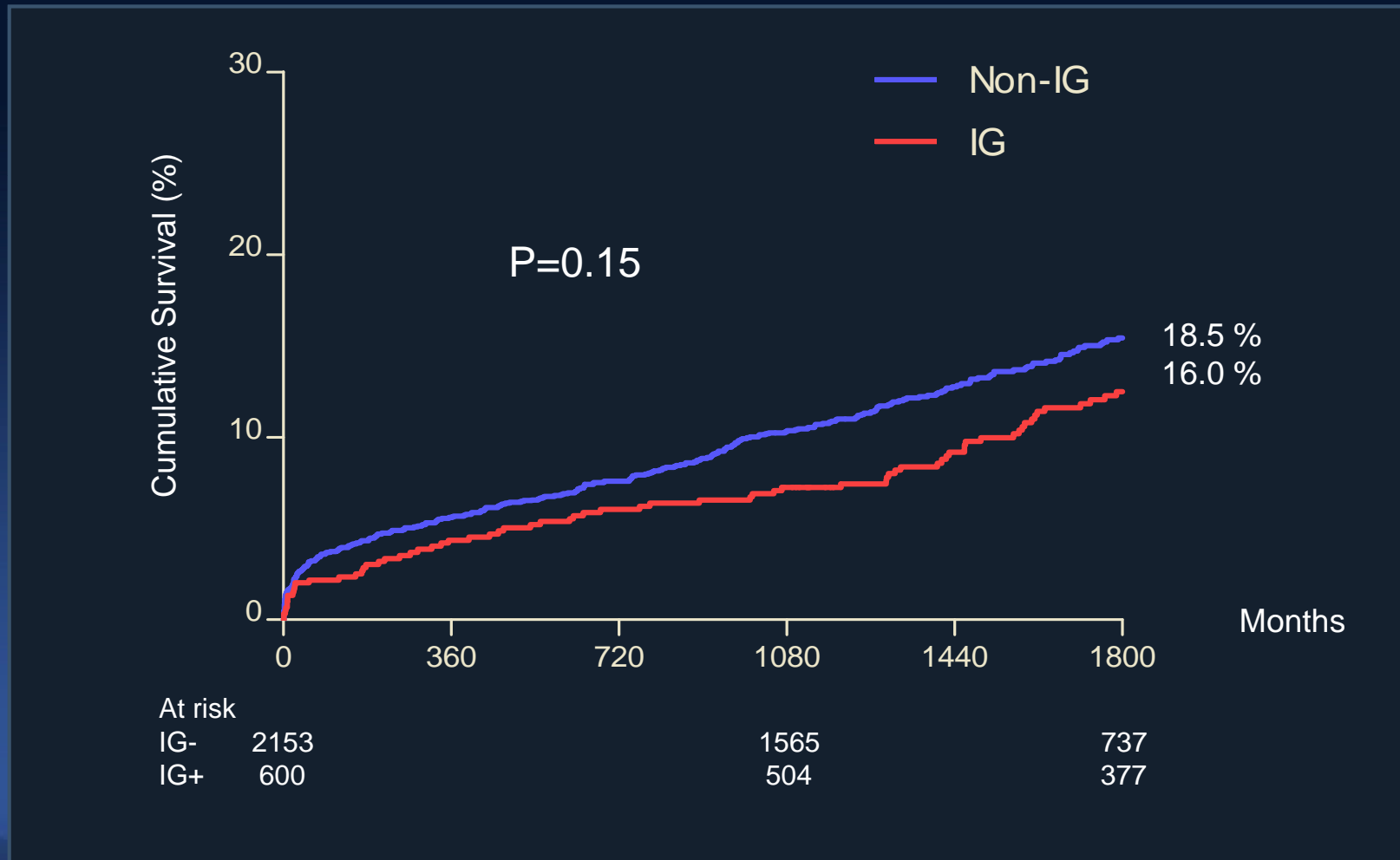
PCI Patients

MACCE for 5 Years



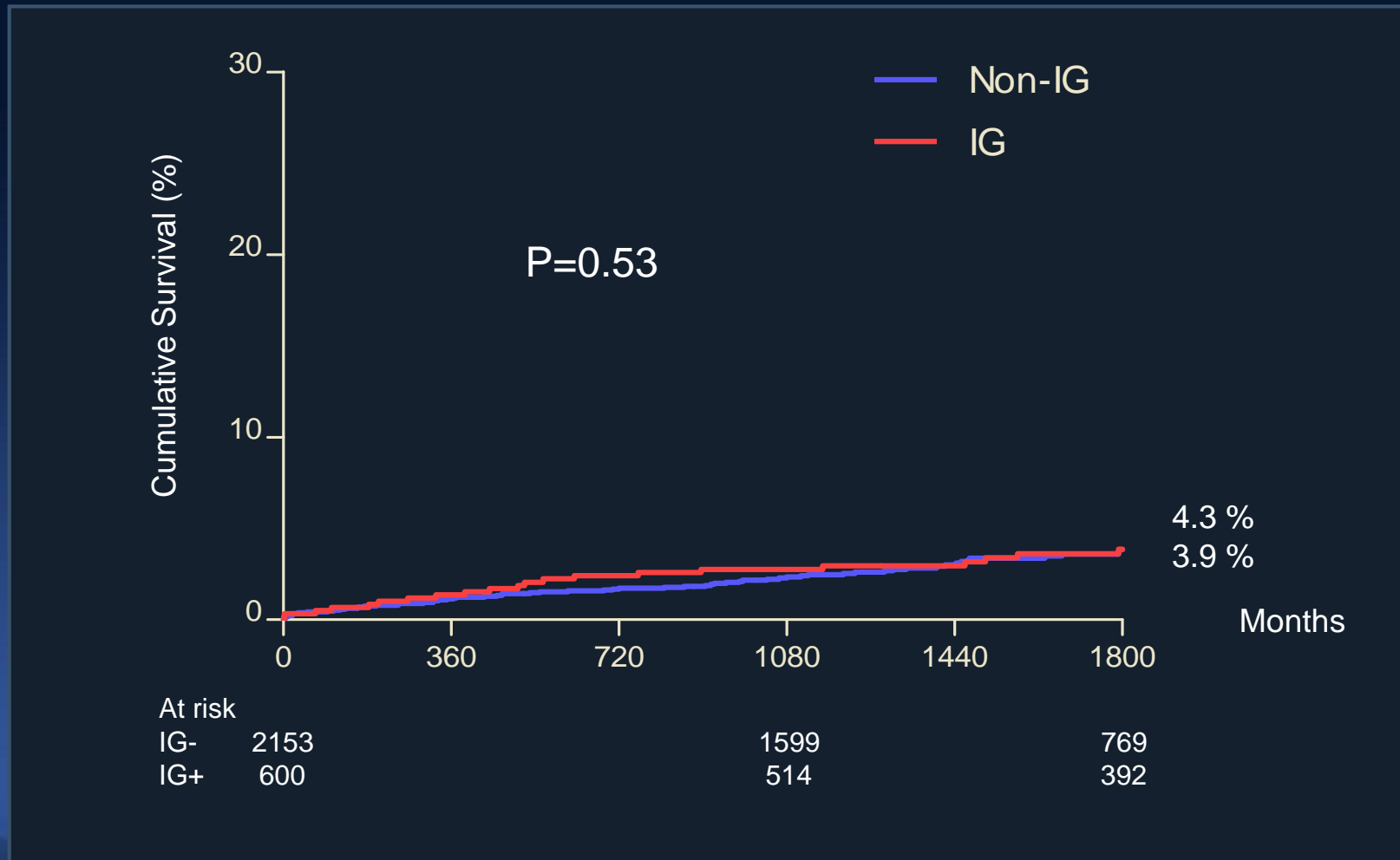
CABG Patients

Death, MI, or Stroke for 5 Years

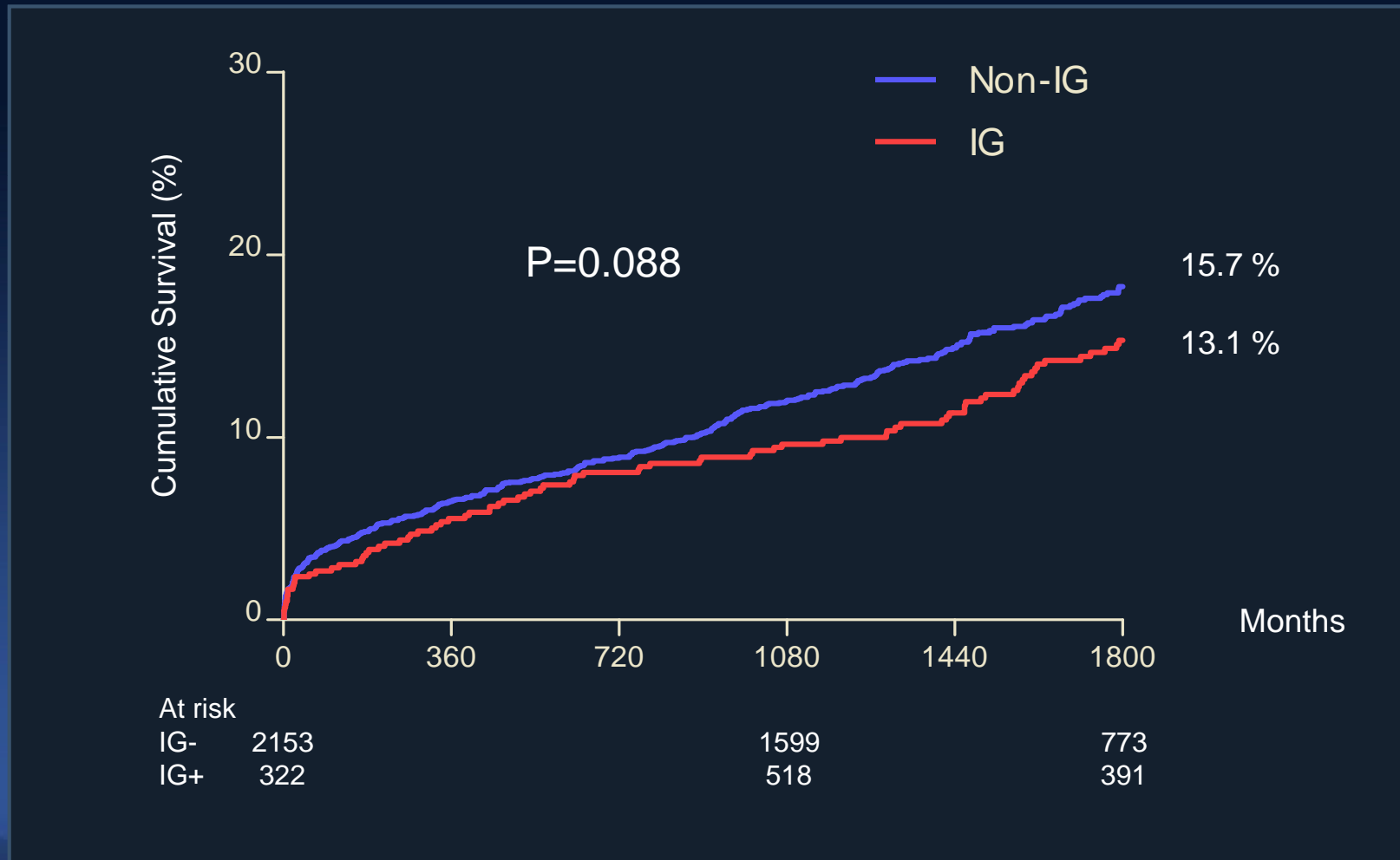


CABG Patients

Repeat Revascularization for 5 Years



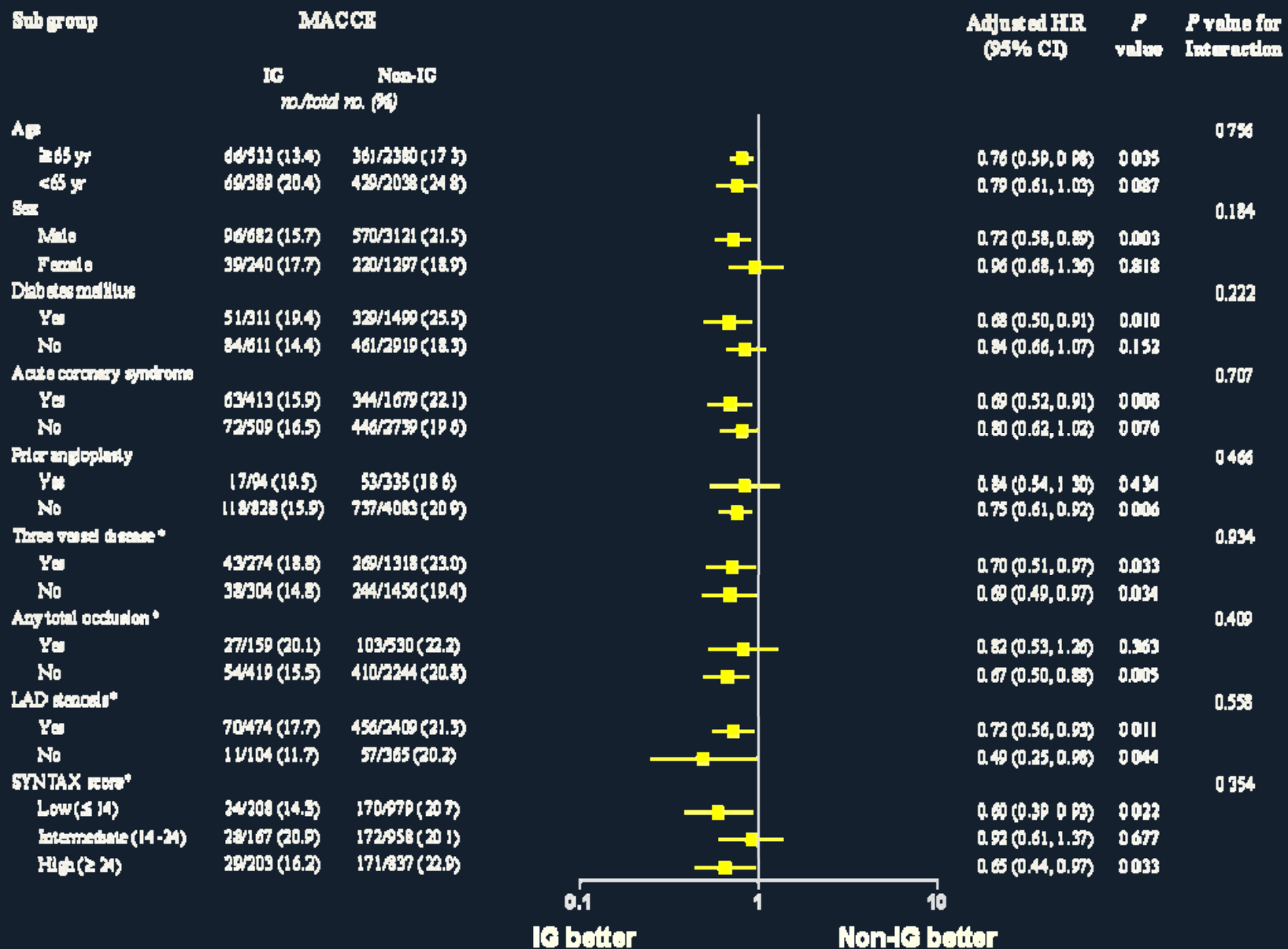
CABG Patients *MACCE for 5 Years*



Adjusted Hazards using Inverse-probability-of-treatment weighting

		HR	95% CI		<i>P</i>	Interaction <i>P</i>
			Lower	Upper		
Death, MI, stroke	All	0.84	0.66	1.06	0.13	0.96
	PCI	0.83	0.53	1.29	0.41	
	CABG	0.82	0.61	1.10	0.18	
Repeat revascularization	All	0.66	0.49	0.90	0.009	0.044
	PCI	0.53	0.35	0.80	0.003	
	CABG	1.16	0.70	1.94	0.57	
MACCE	All	0.73	0.60	0.88	0.001	0.18
	PCI	0.59	0.43	0.81	0.001	
	CABG	0.87	0.67	1.14	0.32	

5-Year MACCE in Subgroups



Ischemia-Guided Revascularization

- IG revascularization may extend the indication of PCI compared with angiography-guided revascularization.
- It may be a more cost-effective way of PCI with fewer devices (DESs).
- It may improve long-term clinical outcomes of PCI.
- Smart noninvasive imaging modalities, which adequately detect ischemic patients, vessels and lesions to improve the diagnostic performance of CAD and to delineate ischemic segments for IG revascularization.

Ischemia-detection using Perfusion CT, MR or others

