

The Rationale Behind Staged Revascularization in ACS (STEMI..)

Youngkeun Ahn, MD, PhD, FACC, FSCAI

**Cell Regeneration Research Center (CRRC),
Cardiology, Cardiovascular Center,
Chonnam National University Hospital
Chonnam National University Medical School,
Gwangju, Korea**

Disclosure

- Grants / Research Support

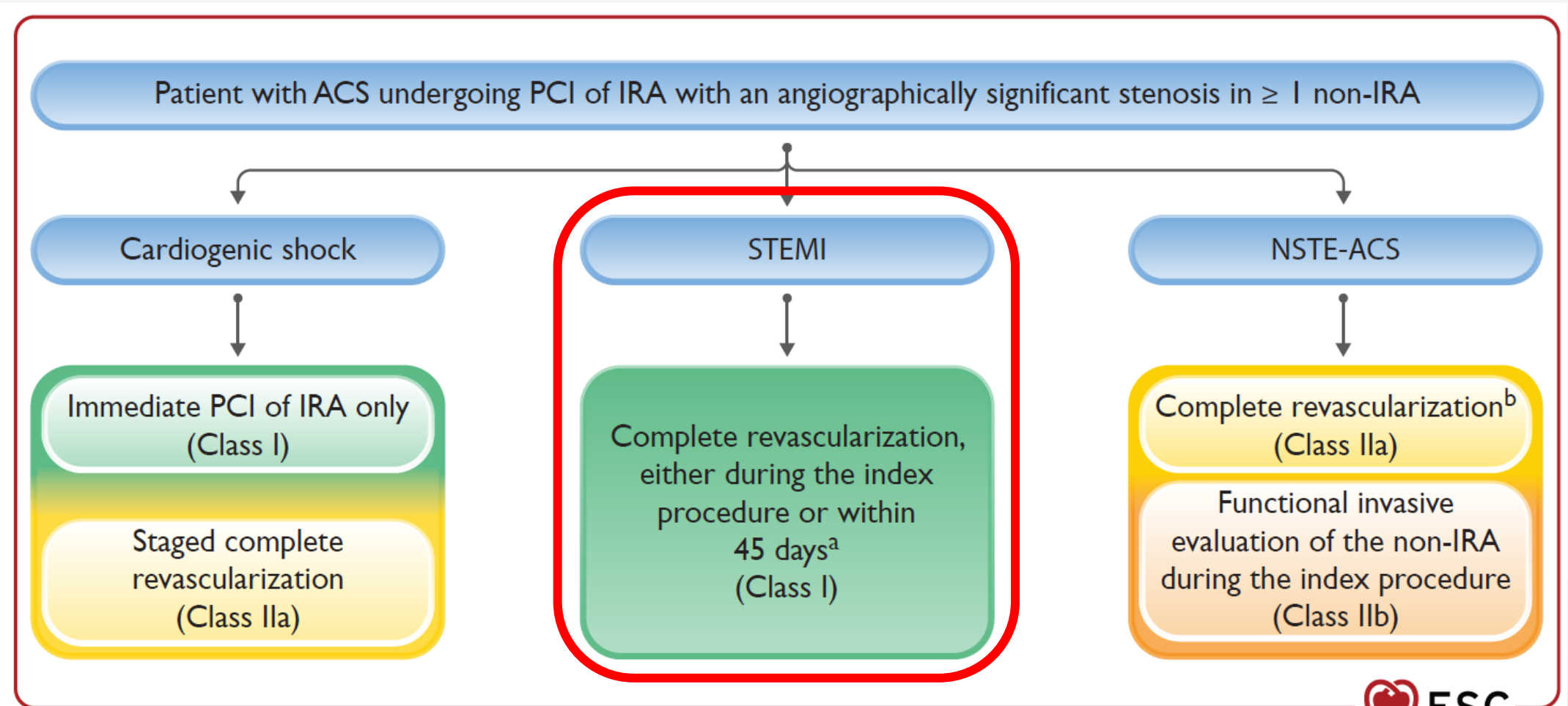
Boston Scientific

Medtronic

Abbott

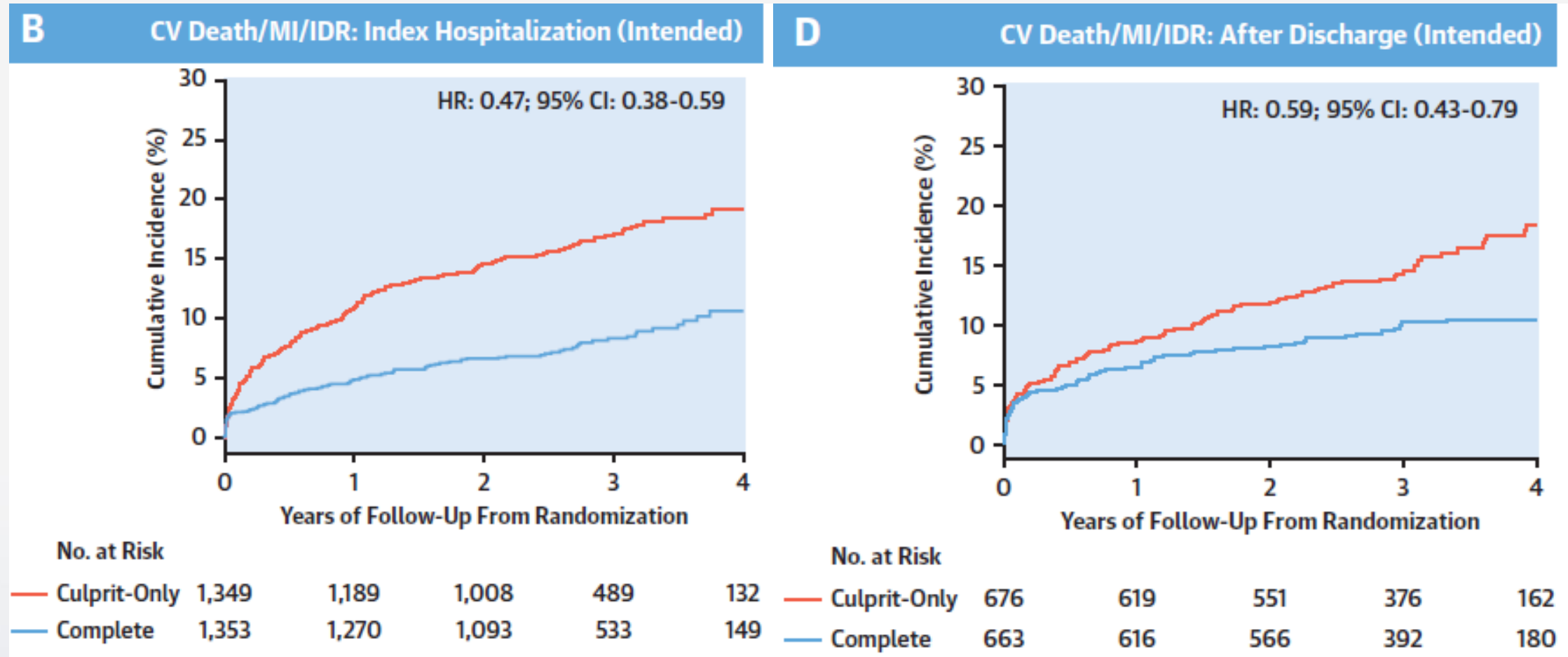
STEMI with MVD

Recent Revascularization Guideline

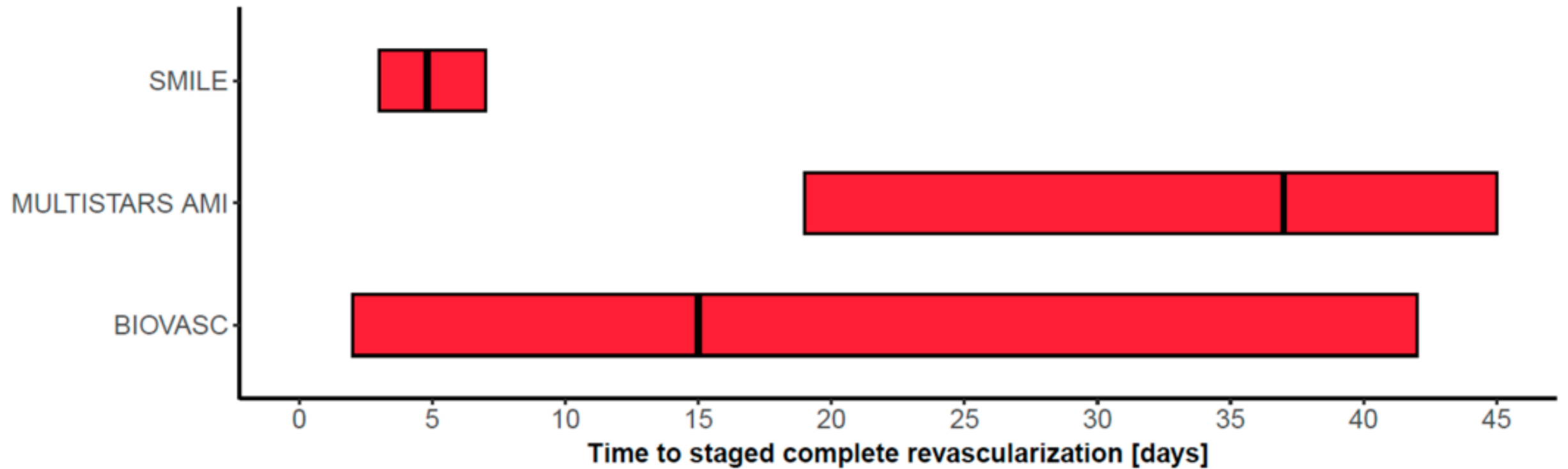


Timing of Non-Culprit Vessel PCI in STEMI

Benefit of CR was consistent irrespective of timing of NCV PCI

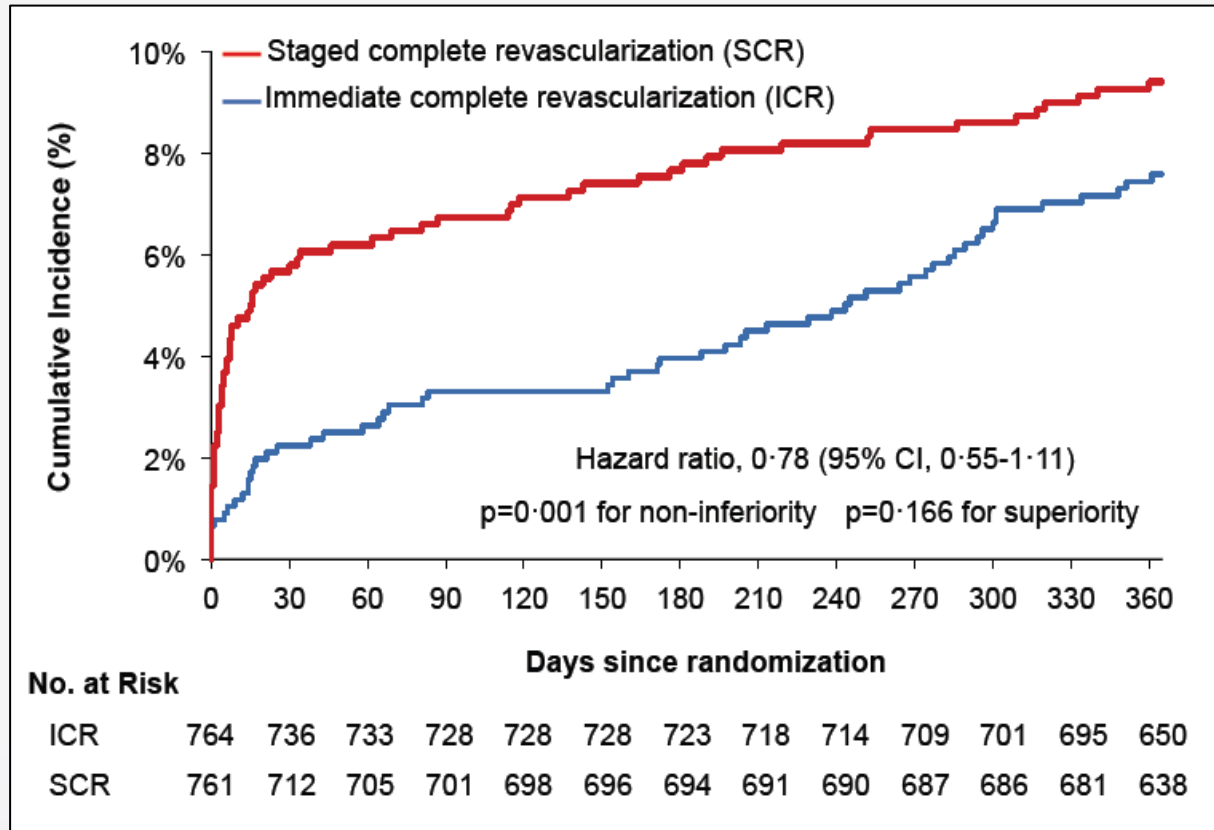


Timing?

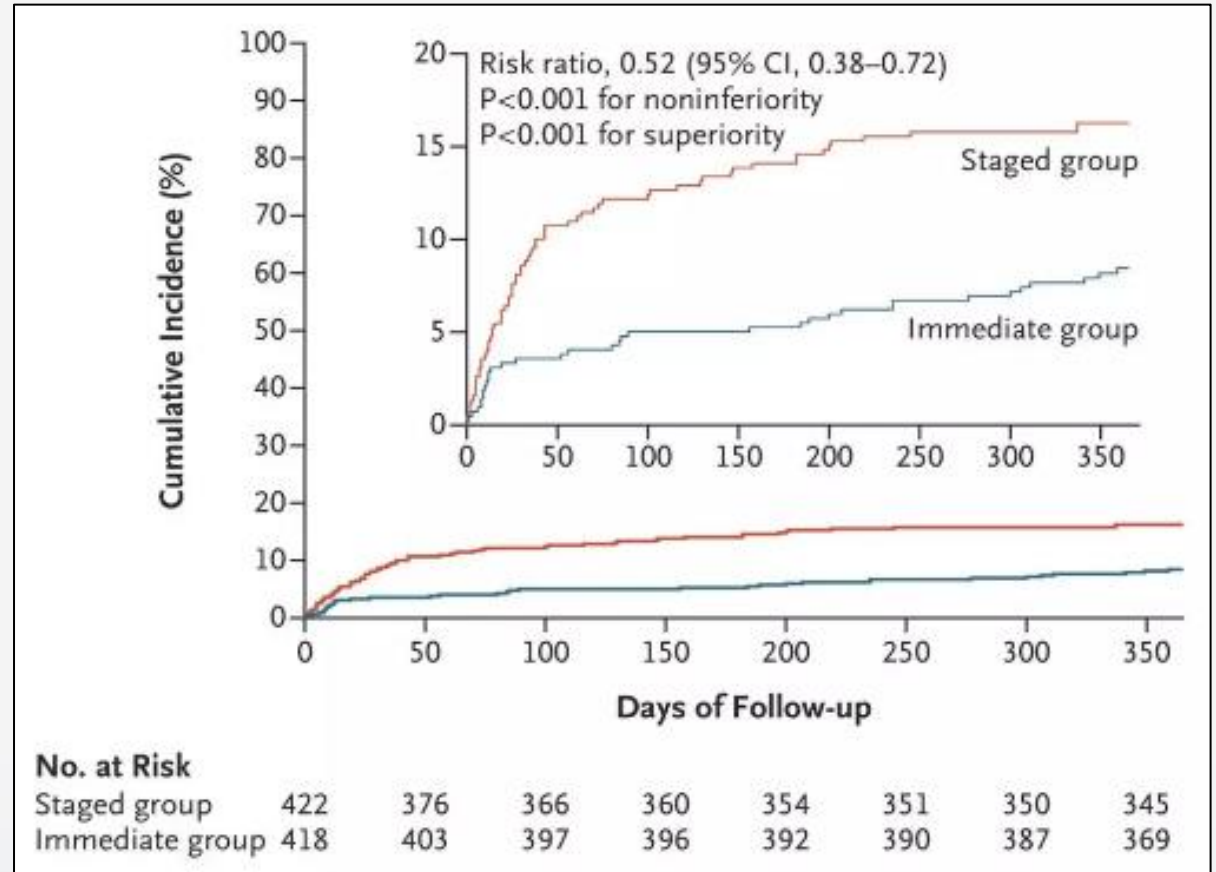


Recent Major RCTs

Non-inferior results with Immediate CR compared with Staged CR



All-cause mortality, MI, any unplanned IDR, or CVEs



Death from any cause, nonfatal MI, stroke, unplanned IDR, or hospitalization for HF

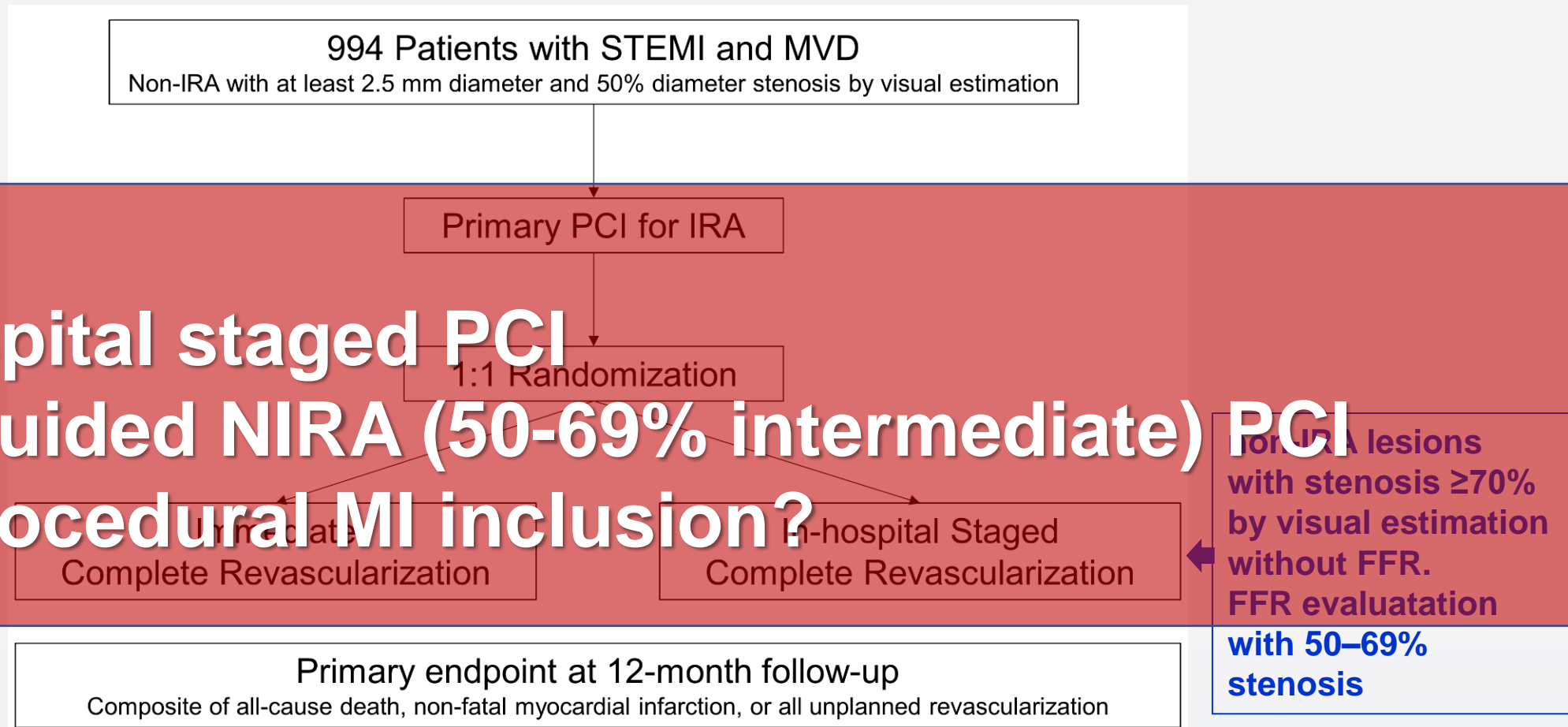
Lancet. 2023;401:1172-1182 (BIOVASC)

N Engl J Med. 2023;389:1368-1379 (MULTISTARS)

OPTION-STEMI study

OPTimal **TI**ming of Fractional Flow Reserve-Guided Complete Revascularizati**ON** for Non-infarct Related Artery in **ST**-Segment **E**levation **M**yocardial **I**nfarction with Multivessel Disease

Protocol Overview (NCT04626882)



- In hospital staged PCI
- FFR-guided NIRA (50-69% intermediate) PCI
- Periprocedural MI inclusion?

Secondary Endpoints: all-cause death, cardiac death, non-cardiac death, non-fatal MI, hospitalization for UA, HF, major bleeding, stroke, CIN, ST during 1-year

In Our Thoughts, However..

Immediate CR: Increased Risk of Cardiac Death and Stent Thrombosis

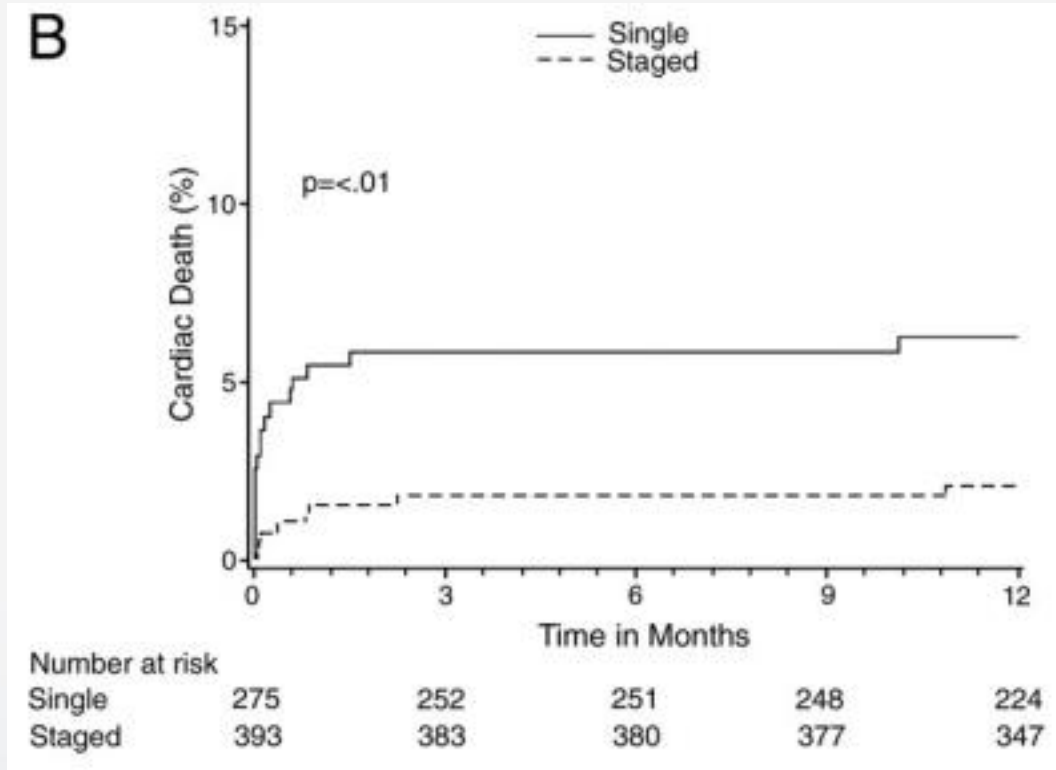
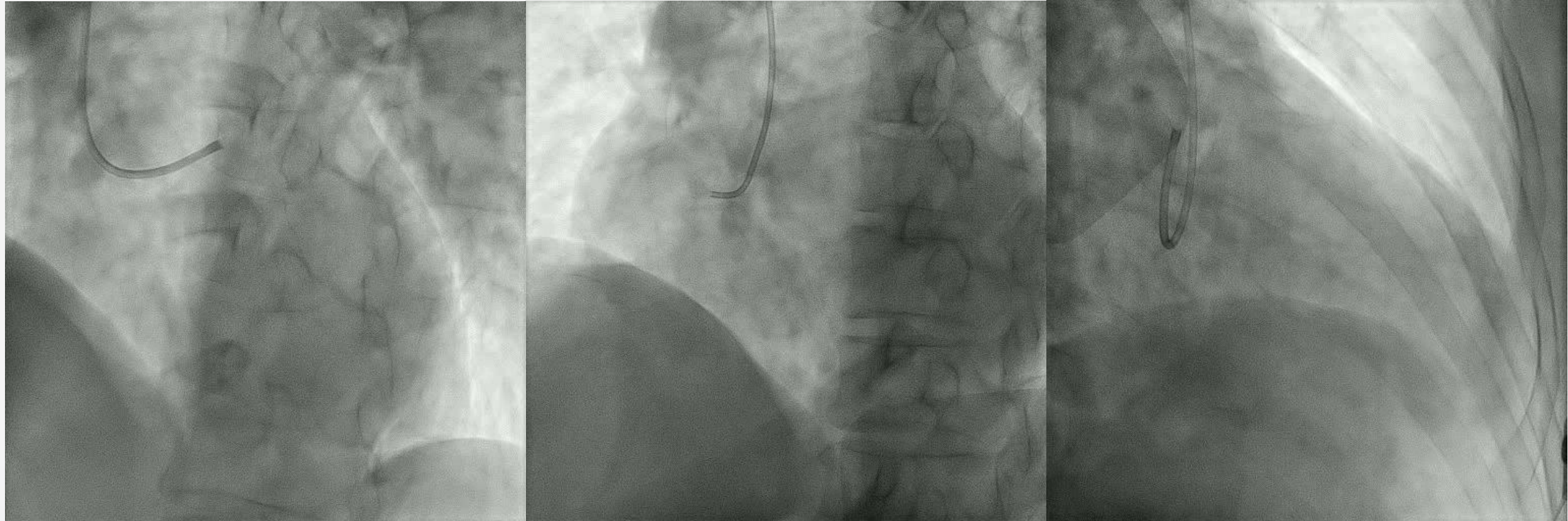


Table 2 Adverse Events at 1 Year

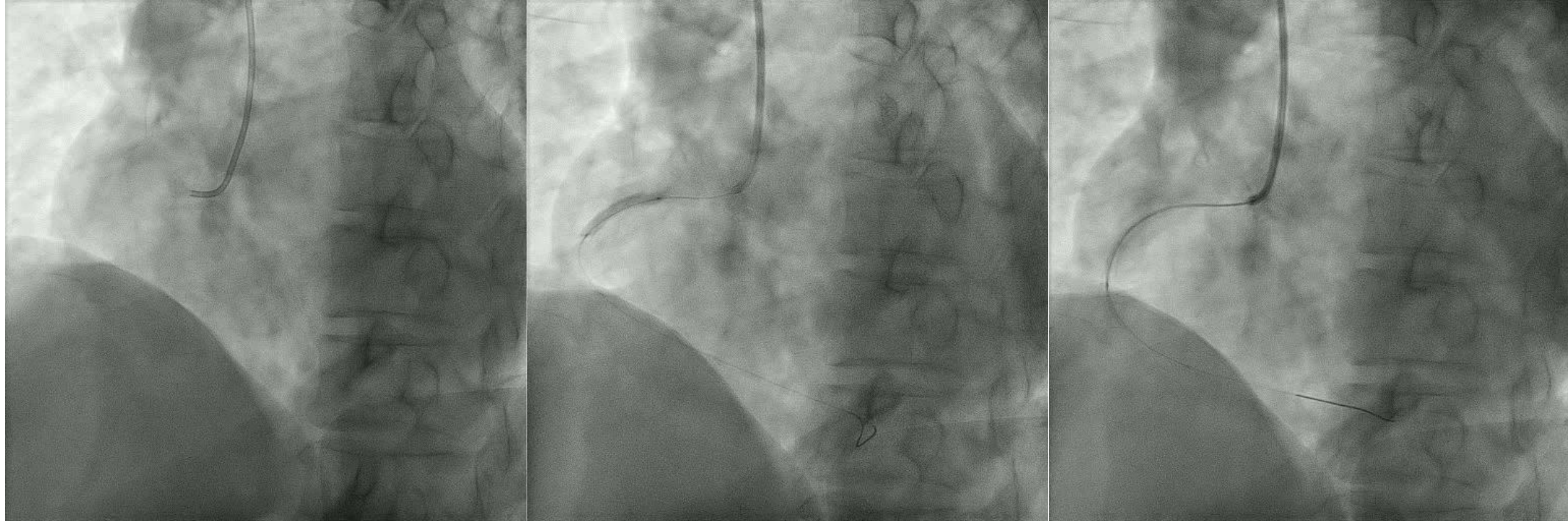
	Single PCI (n = 275)	Staged PCI (n = 393)	RR (95% CI)	p Value
Mortality, all causes, %	9.2	2.3	4.10 (1.93–8.86)	<0.0001
Cardiac, %	6.2	2.0	3.14 (1.35–7.27)	0.005
Reinfarction (Q/non-Q)	6.5	4.7	1.43 (0.73–2.77)	0.29
Ischemic TVR, n	8.9	8.1	1.13 (0.66–1.93)	0.66
Stroke, total	0.4	0.8	0.51 (0.05–4.89)	0.55
Stent thrombosis, n/total n				
Definite	5.0	1.6	3.24 (1.23–8.54)	0.01
Probable	0.8	0.8	0.99 (0.16–5.90)	0.99
Definite or probable	5.7	2.3	2.49 (1.09–5.70)	0.02
Acute (0–24 h)	0.7	1.0	0.72 (0.13–3.88)	0.99
Acute/subacute (0–30 days)	4.8	1.8	2.66 (1.07–6.58)	0.03
Late (>30–365 days)	0.8	0.5	1.53 (0.22–10.9)	0.67
MACE	18.1	13.4	1.42 (0.96–2.1)	0.08

Case 1 (66/F Ant. STEMI with MVD)



**Thrombotic total occlusion in pLAD, 95% focal stenosis in mRCA
Successful PCI for pLAD with BP-EES 2.75x28 mm**

Case 1 (66/F Ant. STEMI with MVD)

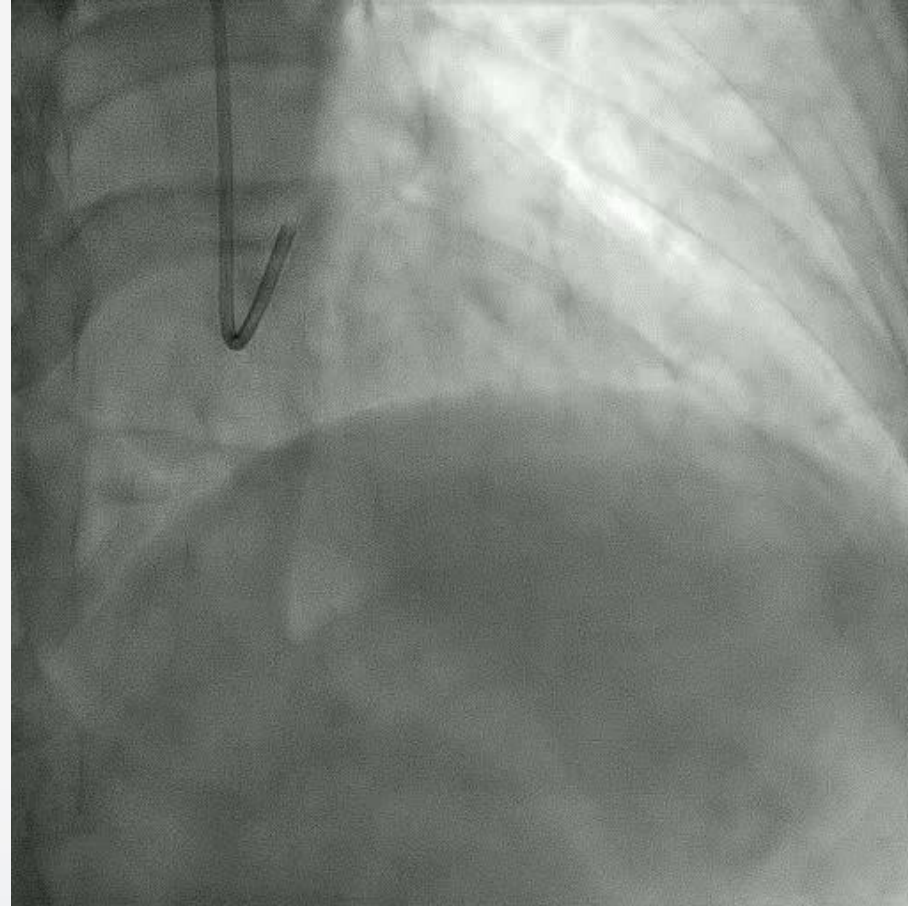


Successful PCI to mRCA with BP-EES 3.0x24 mm

But..

Sudden decreased in SBP with severe chest pain

Case 1 (66/F Ant. STEMI with MVD)



**Acute stent thrombosis in p-mLAD stent (Definite ST)
During immediate CR procedure to NCL**

Thrombogenicity in AMI

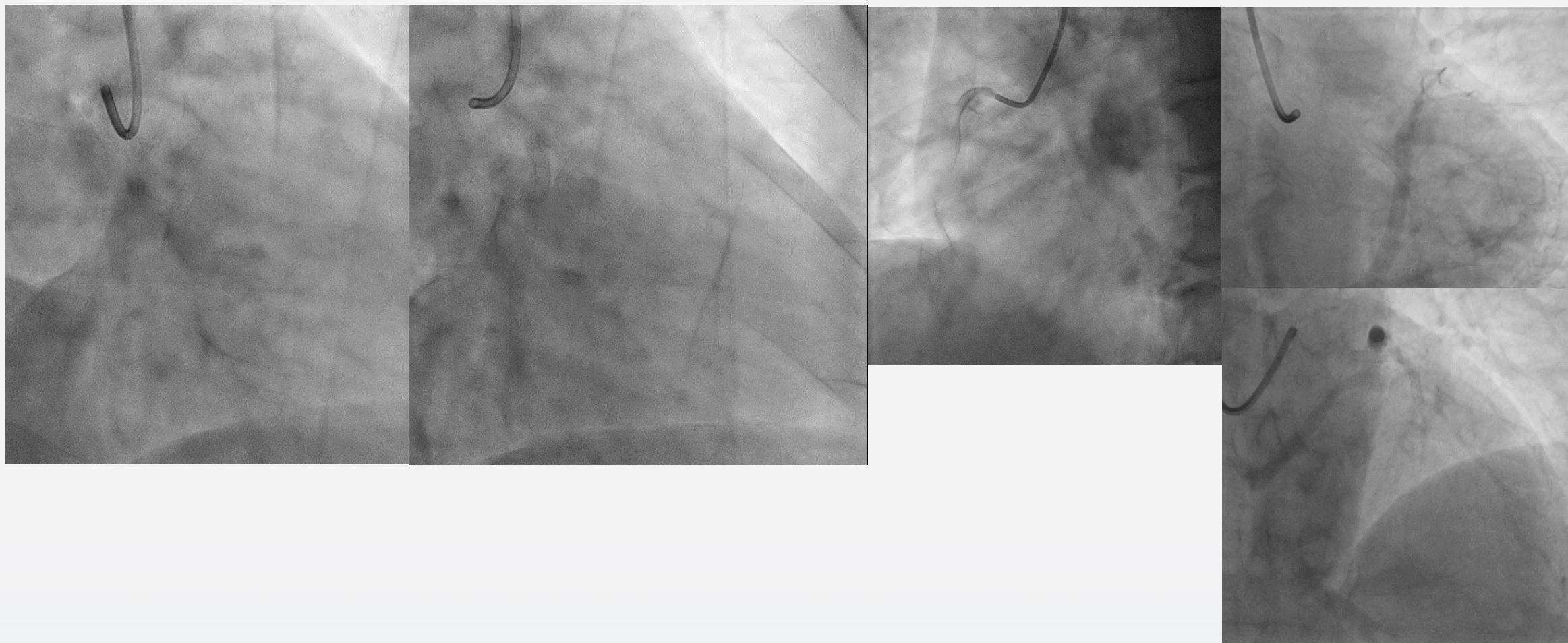
AMI patients are thrombogenic compared with non-AMI patients

Table 3 Predictors of index AMI presentation

Table 2		Univariable analysis		Multivariable analysis ^a		P-value
		Odds ratio (95% CI)	P-value	Odds ratio (95% CI)	P-value	
	MA (every 1 mm increase)	1.022 (1.011–1.032)	<0.001	1.024 (1.013–1.036)	<0.001	
R, min	LY ₃₀ (every 1% increase)	0.922 (0.883–0.962)	<0.001	0.934 (0.893–0.978)	0.004	0.134
K, min	Age (every 1 year increase)	1.007 (1.001–1.013)	0.031	1.023 (1.015–1.031)	<0.001	0.160
Angle, d	Body mass index (every 1 kg/m ² increase)	0.951 (0.930–0.973)	<0.001	0.938 (0.914–0.962)	<0.001	0.077
MA, mm	Current smoking	2.292 (1.936–2.713)	<0.001	2.234 (1.853–2.693)	<0.001	0.001
MA ≥68	Diabetes mellitus	0.741 (0.629–0.871)	<0.001	-	-	0.001
LY ₃₀ , %	Hypertension	0.749 (0.644–0.871)	<0.001	-	-	0.001
LY ₃₀ < 0.2	Dyslipidemia	1.781 (1.528–2.076)	<0.001	1.703 (1.440–2.014)	<0.001	0.001
	Previous PCI	0.491 (0.393–0.615)	<0.001	0.602 (0.475–0.764)	<0.001	0.001
	Hemoglobin (every 1 g/dL increase)	1.129 (1.087–1.173)	<0.001	1.161 (1.107–1.217)	<0.001	

High platelet-fibrin clot strength (MA ≥68 mm) and low fibrinolytic activity (LY₃₀ < 0.2%)

Case 2 (68/M Post. STEMI)



**Successful PCI for pLCX subtotal lesion using DP-EES 2.75x48 mm
Insignificant stenosis in RCA**

Focal stenosis up to 50% in osLAD, Diffuse stenosis up to 50% in mLAD

Physiologic Study to NCV in Acute Stage

Areas of Debate



CLINICAL RESEARCH

Fractional Flow Reserve for the Assessment of Nonculprit Coronary Artery Stenoses in Patients With Acute Myocardial Infarction

Argyrios Ntalianis, MD, PhD,* Jan-Willem Sels, MD,† Giedrius Davidavicius, MD,‡ Nobuhiro Tanaka, MD,§ Olivier Muller, MD, PhD,* Catalina Trana, MD,* Emanuele Barbato, MD, PhD,* Michalis Hamilos, MD, PhD,* Fabio Mangiacapra, MD,* Guy R. Heyndrickx, MD, PhD,* William Wijns, MD, PhD,* Nico H. J. Pijls, MD, PhD,† Bernard De Bruyne, MD, PhD*

Fractional Flow Reserve and Instantaneous Wave-Free Ratio for Nonculprit Stenosis in Patients With Acute Myocardial Infarction



Ki Hong Choi, MD,^a Joo Myung Lee, MD, MPH, PhD,^a Hyun Kuk Kim, MD, PhD,^b Jihoon Kim, MD,^a Jonghanne Park, MD,^c Doyeon Hwang, MD,^c Tae-Min Rhee, MD,^c Taek Kyu Park, MD, PhD,^a Jeong Hoon Yang, MD,^{a,d} Young Bin Song, MD, PhD,^a Eun-Seok Shin, MD, PhD,^{e,f} Chang-Wook Nam, MD, PhD,^g Joon-Hyung Doh, MD, PhD,^h Joo-Yong Hahn, MD, PhD,^a Jin-Ho Choi, MD, PhD,^a Seung-Hyuk Choi, MD, PhD,^a Bon-Kwon Koo, MD, PhD,^{c,i} Hyeon-Cheol Gwon, MD, PhD^a

JAMA Cardiology | Original Investigation

Temporal Changes in Coronary Hyperemic and Resting Hemodynamic Indices in Nonculprit Vessels of Patients With ST-Segment Elevation Myocardial Infarction

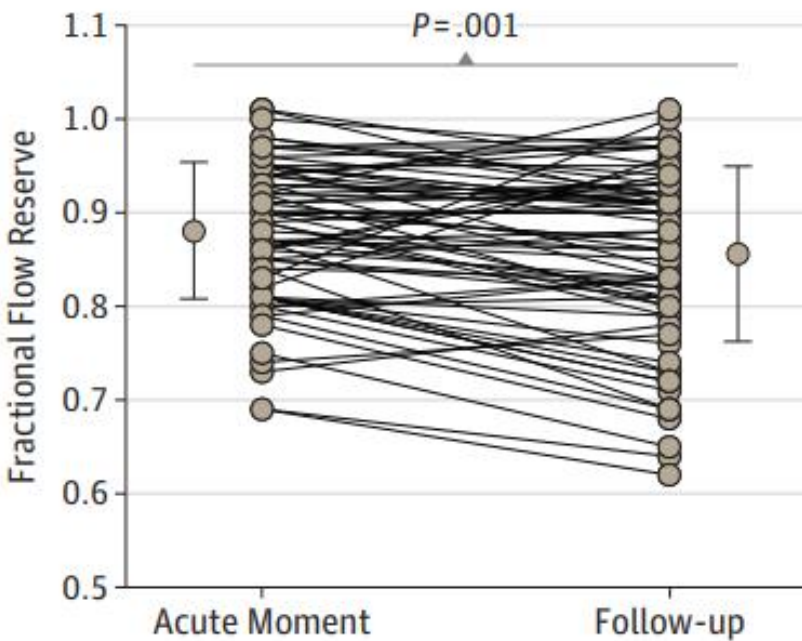
Nina W. van der Hoeven, MD; Gladys N. Janssens, MD; Guus A. de Waard, MD; Henk Everaars, MD; Christopher J. Broyd, MD, PhD; Casper W.H. Beijinck, BSc; Peter M. van de Ven, PhD; Robin Nijveldt, MD, PhD; Christopher M. Cook, MD, PhD; Ricardo Petraco, MD, PhD; Tim ten Cate, MD, PhD; Clemens von Birgelen, MD, PhD; Javier Escaned, MD, PhD; Justin E. Davies, MBBS, PhD; Maarten A.H. van Leeuwen, MD; Niels van Royen, MD, PhD

JACC Cardiovasc Interv. 2010;3:1274-1281
JACC Cardiovasc Interv. 2018;18:1848-1858
JAMA Cardiol. 2019;4:736-744

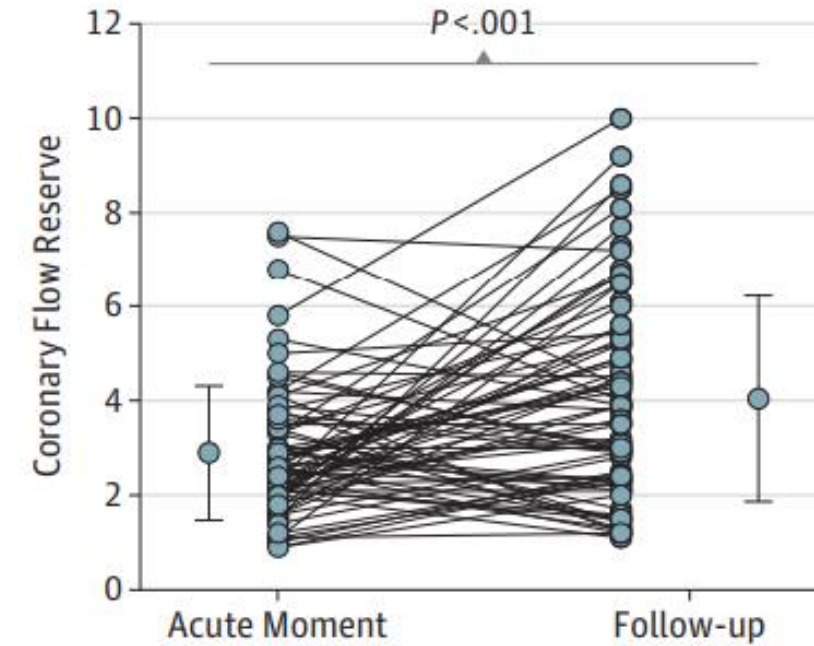
Physiologic Study to NCV in Acute Stage

Acute setting of STEMI: NCV CFR was reduced and FFR was augmented

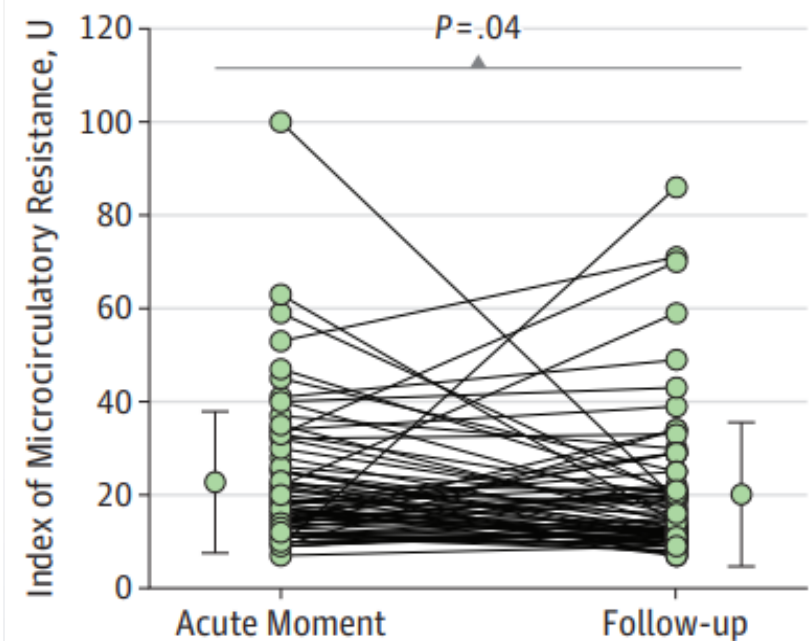
E Change in mean FFR



B Change in mean CFR



H Change in mean IMR



Multivessel disease in haemodynamically stable STEMI patients undergoing PPCI

Complete revascularization is recommended either during the index PCI procedure or within 45 days.^{508–511,531}

I

A

It is recommended that PCI of the non-IRA is based on angiographic severity.^{511,524}

I

B

Invasive epicardial functional assessment of non-culprit segments of the IRA is not recommended during the index procedure.

III

C

Multivessel disease in haemodynamically stable NSTEMI-ACS patients undergoing PCI

In patients presenting with NSTEMI-ACS and MVD, complete revascularization should be considered, preferably during the index procedure.^{513,514}

IIa

C

Functional invasive evaluation of non-IRA severity during the index procedure may be considered.^{518,527,528,532}

IIb

B

Pitfalls in Recent RCTs

Percutaneous complete revascularization strategies using sirolimus-eluting biodegradable polymer-coated stents in patients presenting with acute coronary syndrome and multivessel disease: rationale and design of the BIOVASC trial



■ PCI related MI

Wijnand K. den Dekker, MD, PhD,^a Nicolas M. Van Mieghem, MD, PhD,^a Johan Bennett, MD, PhD,^b Manel Sabate, MD, PhD,^c Giovanni Esposito, MD, PhD,^d Rutger J. van Bommel, MD, PhD,^c Joost Daemen, MD, PhD,^a Matthias Vrolix, MD, PhD,^f Paul A. Cummins, RN,^a Mattie J. Lenzen, PhD,^a Eric Boersma, MD, PhD,^a Felix Zijlstra, MD, PhD,^a and Roberto Diletti, MD, PhD^a *Rotterdam, the Netherlands; Leuven, Belgium; IDIBAPS, Barcelona, Spain; Naples, Italy; Tergooi Blaricum, Blaricum, the Netherlands; and Genk, Belgium*
on Behalf of the BioVasc Trial Investigators

Rationale and design of the MULTISTARS AMI Trial: A randomized comparison of immediate versus staged complete revascularization in patients with ST-segment elevation myocardial infarction and multivessel disease

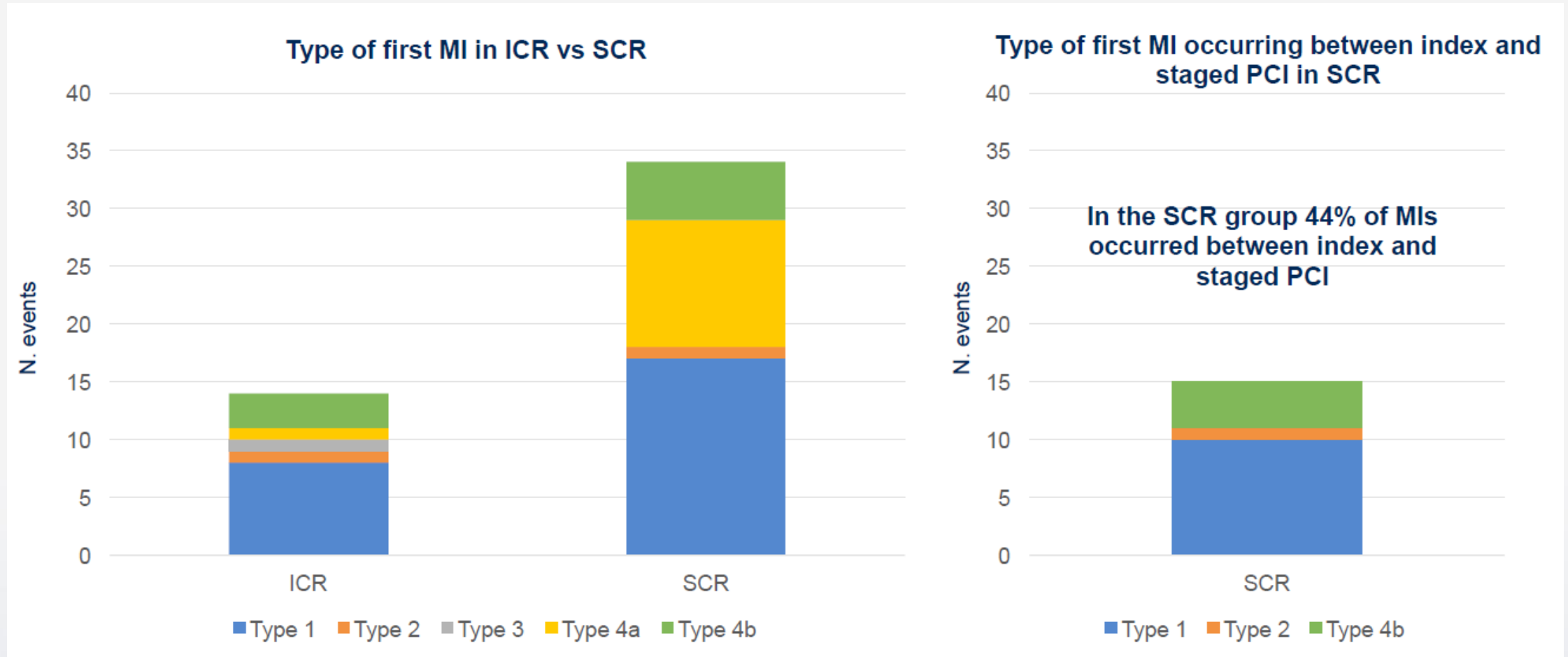


Sandra H. Kristán, MD, MBA,^a Ferdinando Varbella, MD,^b Bettina Schwarz, MD,^c Peter Nordbeck, MD,^d Stephan Linke, MD,^e Irene M. Lang, MD,^f Aurel Toma, MD,^f Marco Moccetti, MD,^g Christian Valina, MD,^h Matteo Vercellino, MD,ⁱ Angelos G. Rigopoulos, MD,^j Miklos Rohla, MD,^k Matthias Schindler, PhD,^a Manfred Wischnowsky, PhD,^l Axel Linke, MD,^m P. Christian Schulze, MD,ⁿ Gert Richardt, MD,^c Karl-Ludwig Laugwitz, MD,^o Franz Weidinger, MD,^p Wolfgang Rottbauer, MD,^q Stephan Achenbach, MD,^r Kurt Huber, MD,^k Franz-Josef Neumann, MD,^h Adnan Kastrati, MD,^s Ian Ford, PhD,^t Frank Ruschitzka, MD,^a and Willibald Maier, MD^a, on behalf of the MULTISTARS AMI Investigators

3. PCI-related myocardial infarction (MI type 4a): Elevation of cTn values $>5 \times 99^{\text{th}}$ percentile occurring within 48 hours of the procedure in patients with normal baseline values ($\leq 99^{\text{th}}$ percentile), or a rise of cTn values >20 percent if baseline values are elevated or are stable or falling. In addition, either new or aggravating prolonged (>20 min) symptoms suggestive of myocardial ischemia, or new persistent ischemic ST segment changes or new pathological Q waves, or angiographic evidence of a flow-limiting complication such as persistent occlusion or persistent slow-flow, no-reflow, or embolization, and/or angiographic evidence of persistent loss of patency of a major (≥ 2.0 mm) side branch, or imaging evidence of new loss of viable myocardium or new regional wall motion abnormality are required.

Pitfalls in Recent RCTs

Inclusion of type 4a MI (Peri-procedural MI)



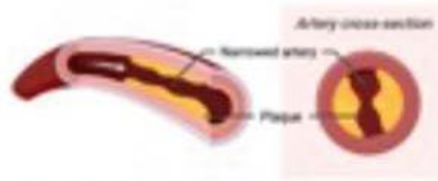
Cons of an Immediate CR in STEMI

Vasoconstriction in the acute phase



Unnecessary implantation of stents that are smaller than needed?

Significance of non-culprit lesions



No role for physiological indices (e.g., FFR) during the acute phase

Suboptimal antiplatelet inhibition



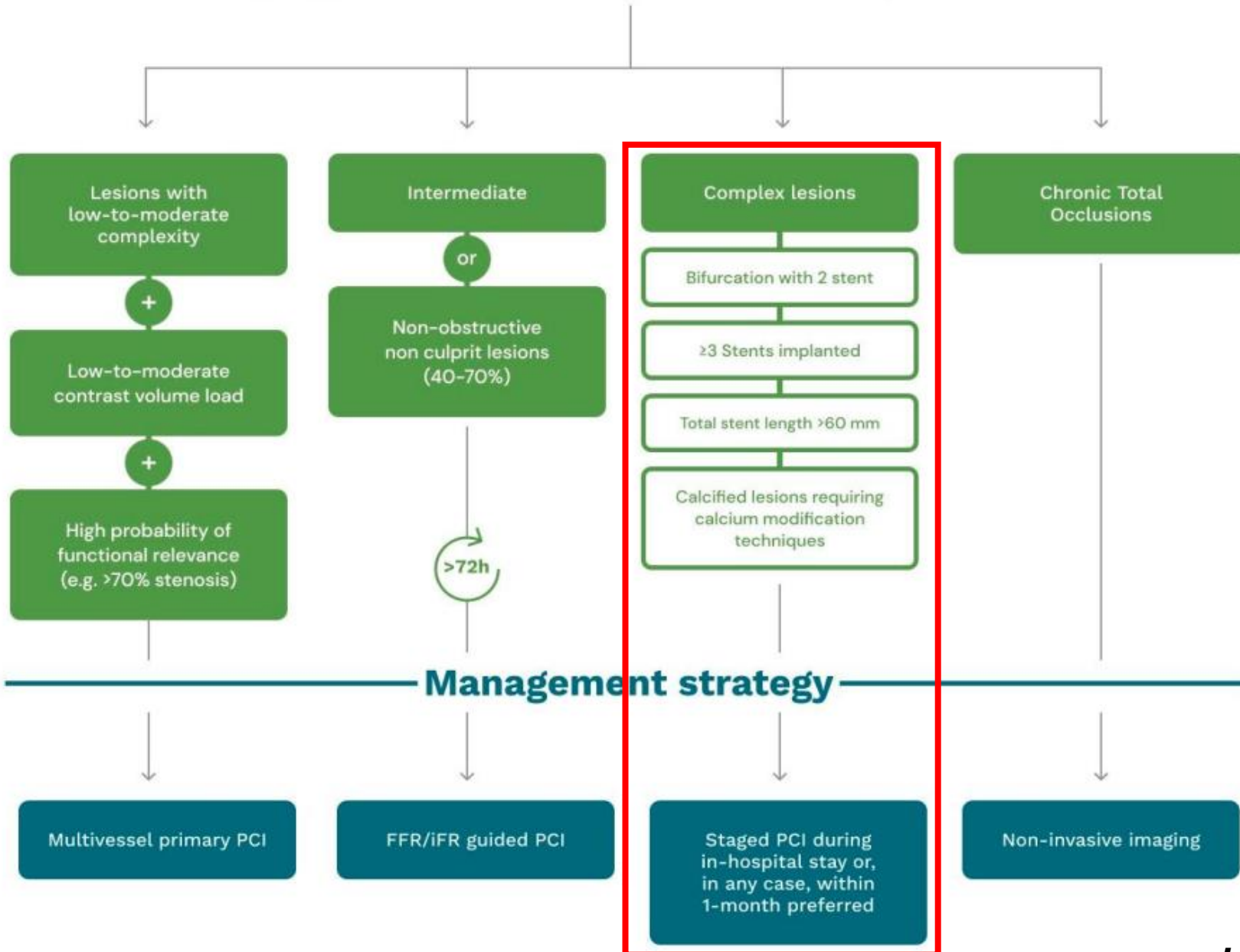
↑ risk of stent thrombosis, especially in high-risk lesions and multiple stents

Early revascularisation or early intensive care treatment?



Is delayed intensive care counterbalanced by the benefits of early complete revascularisation?

Angiographic assessment of non culprit lesion



Conclusion

- Thrombogenicity is superior in AMI compared with non-AMI.
- Vasoconstriction and suboptimal anti-platelet inhibition in index procedure, complex lesion and un-determined modality for functional significance in NIRA, beneficial early intensive care after index procedure could be preferred option in staged PCI.
- **OPTION-STEMI** will find the outcome of in-hospital staged PCI and FFR-guided intermediate NIRA PCI.