Celebration of LM PCI: Joy in Growth, Journeying Towards 25 Years

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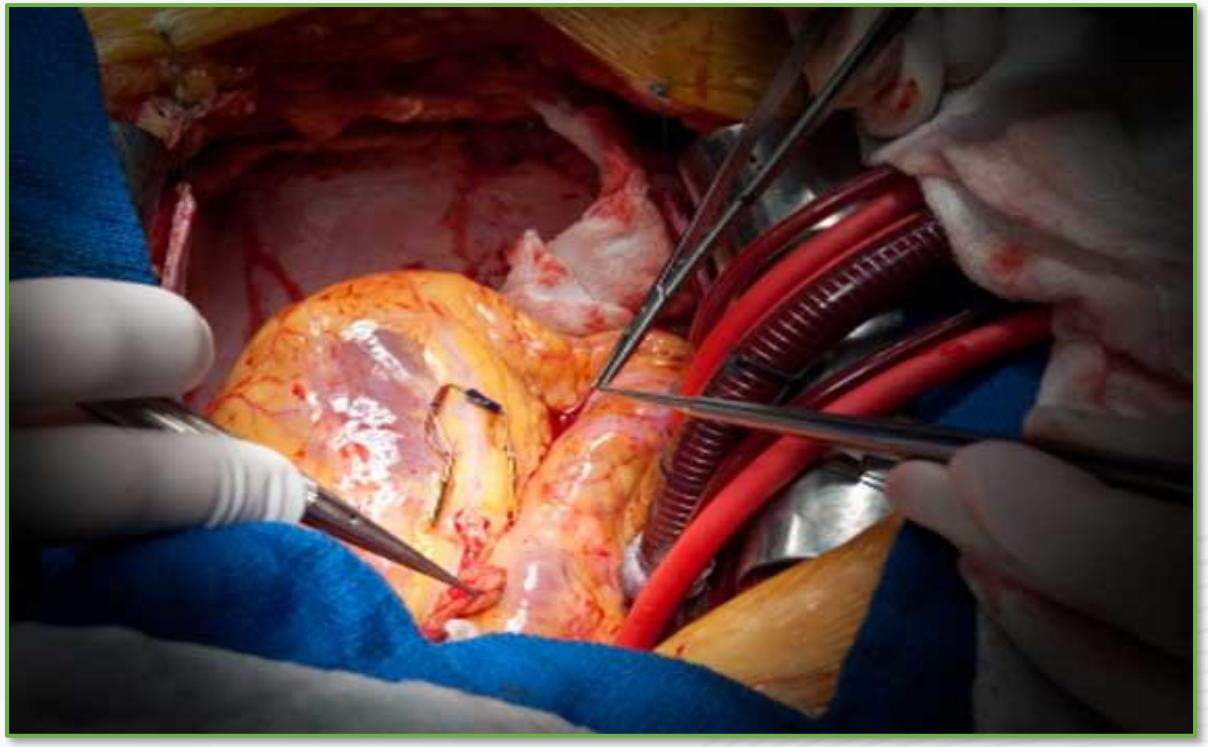
Disclosure

- Institutional grant/research funding to CardioVascular Research Foundation (CVRF, Korea) and/or Asan Medical Center from Abbott, Boston Scientific, Medtronics, Daiichi-Sankyo, Edwards Lifescience, HK InnoN, Daewoong Pharm, and ChongKunDang Pharm.

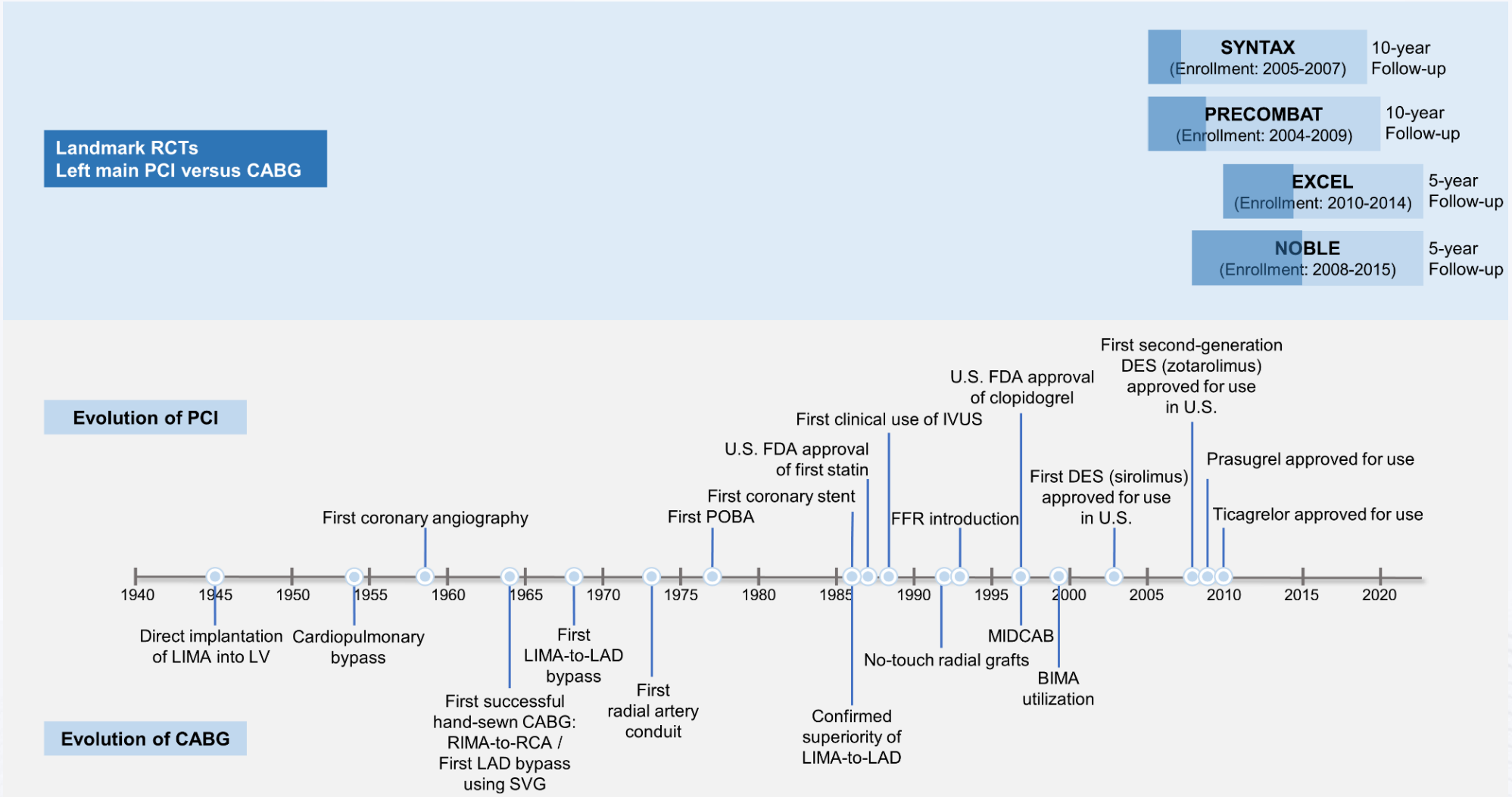
Two Very Different Procedures for Left Main or Multivessel Disease



CABG

PCI

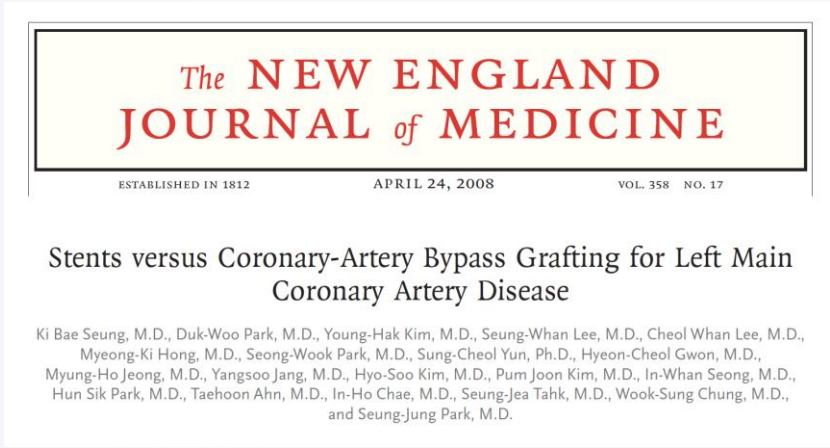
Important Milestones of PCI and CABG and Landmark trials Comparing PCI versus CABG for LM and MVD



SW Park, DW Park et al. KCJ 2023

RCTs Comparing PCI vs. CABG from Asian Populations

MAIN-COMPARE Registry for LM Disease



The NEW ENGLAND JOURNAL of MEDICINE

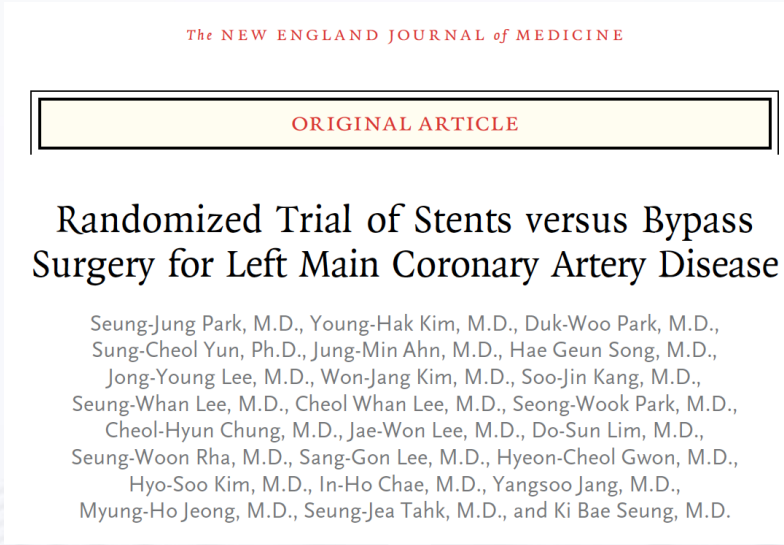
ESTABLISHED IN 1812 APRIL 24, 2008 VOL. 358 NO. 17

Stents versus Coronary-Artery Bypass Grafting for Left Main Coronary Artery Disease

Ki Bae Seung, M.D., Duk-Woo Park, M.D., Young-Hak Kim, M.D., Seung-Whan Lee, M.D., Cheol Whan Lee, M.D., Myeong-Ki Hong, M.D., Seong-Wook Park, M.D., Sung-Cheol Yun, Ph.D., Hyeon-Cheol Gwon, M.D., Myung-Ho Jeong, M.D., Yangsoo Jang, M.D., Hyo-Soo Kim, M.D., Pum Joon Kim, M.D., In-Whan Seong, M.D., Hun Sik Park, M.D., Taehoon Ahn, M.D., In-Ho Chae, M.D., Seung-Jea Tahk, M.D., Wook-Sung Chung, M.D., and Seung-Jung Park, M.D.

N Engl J Med 2008;358:1781-92

PRECOMBAT Trial for LM Disease



The NEW ENGLAND JOURNAL of MEDICINE

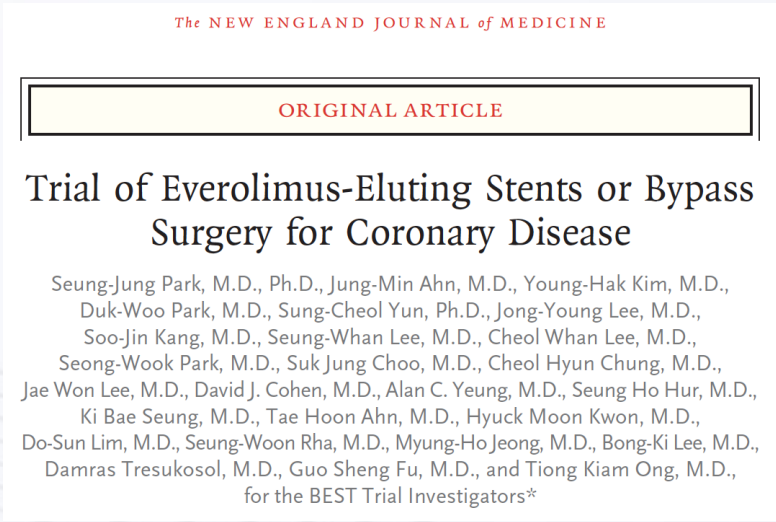
ORIGINAL ARTICLE

Randomized Trial of Stents versus Bypass Surgery for Left Main Coronary Artery Disease

Seung-Jung Park, M.D., Young-Hak Kim, M.D., Duk-Woo Park, M.D., Sung-Cheol Yun, Ph.D., Jung-Min Ahn, M.D., Hae Geun Song, M.D., Jong-Young Lee, M.D., Won-Jang Kim, M.D., Soo-Jin Kang, M.D., Seung-Whan Lee, M.D., Cheol Whan Lee, M.D., Seong-Wook Park, M.D., Cheol-Hyun Chung, M.D., Jae-Won Lee, M.D., Do-Sun Lim, M.D., Seung-Woon Rha, M.D., Sang-Gon Lee, M.D., Hyeon-Cheol Gwon, M.D., Hyo-Soo Kim, M.D., In-Ho Chae, M.D., Yangsoo Jang, M.D., Myung-Ho Jeong, M.D., Seung-Jea Tahk, M.D., and Ki Bae Seung, M.D.

N Engl J Med 2011;364:1718-27

BEST Trial for Multivessel Disease



The NEW ENGLAND JOURNAL of MEDICINE

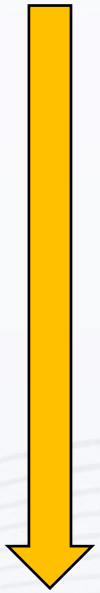
ORIGINAL ARTICLE

Trial of Everolimus-Eluting Stents or Bypass Surgery for Coronary Disease

Seung-Jung Park, M.D., Ph.D., Jung-Min Ahn, M.D., Young-Hak Kim, M.D., Duk-Woo Park, M.D., Sung-Cheol Yun, Ph.D., Jong-Young Lee, M.D., Soo-Jin Kang, M.D., Seung-Whan Lee, M.D., Cheol Whan Lee, M.D., Seong-Wook Park, M.D., Suk Jung Choo, M.D., Cheol Hyun Chung, M.D., Jae Won Lee, M.D., David J. Cohen, M.D., Alan C. Yeung, M.D., Seung Ho Hur, M.D., Ki Bae Seung, M.D., Tae Hoon Ahn, M.D., Hyuck Moon Kwon, M.D., Do-Sun Lim, M.D., Seung-Woon Rha, M.D., Myung-Ho Jeong, M.D., Bong-Ki Lee, M.D., Damras Tresukosol, M.D., Guo Sheng Fu, M.D., and Tiong Kiam Ong, M.D., for the BEST Trial Investigators*

N Engl J Med 2015;372:1204-12

What Type of PCI Is Most Famous in KOREA and Is Ranked #1 in the World?



Left Main PCI

LETTER TO THE EDITOR

First Percutaneous Catheter Intervention for Left Main Coronary Artery Disease: 30 Years Ago

Gruntzig A.
Lancet. 1978 Feb 4;1(8058):263.
Transluminal dilatation of coronary-artery stenosis.

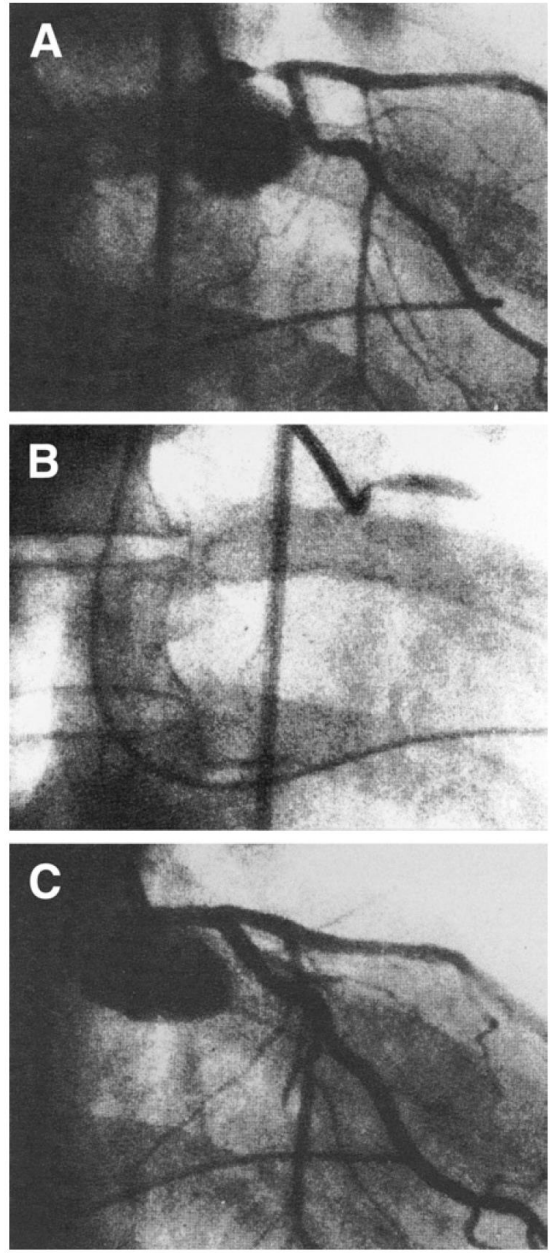


Figure 1. PCI on Awake Human

(A) Eighty percent stenosis of main left coronary artery; **(B)** passage of the dilatation catheter; **(C)** post-procedure angiogram. Reprinted with permission from Elsevier (The Lancet, 1978, 1, 1093).

JACC Vol. 31, No. 1
January 1998:37–42

Stenting of Unprotected Left Main Coronary Artery Stenoses: Immediate and Late Outcomes

SEUNG-JUNG PARK, MD, PHD, FACC, SEONG-WOOK PARK, MD, PHD, MYEONG-KI HONG, MD, SANG-SIG CHEONG, MD, CHEOL WHAN LEE, MD, JAE-JOONG KIM, MD, MUN K. HONG, MD, FACC,* GARY S. MINTZ, MD, FACC,* MARTIN B. LEON, MD, FACC*

Seoul, Korea and Washington, D.C.

Objectives. **We examined the immediate and long-term outcomes after stenting of unprotected left main coronary artery (LMCA) stenoses in patients with normal left ventricular (LV) function.**

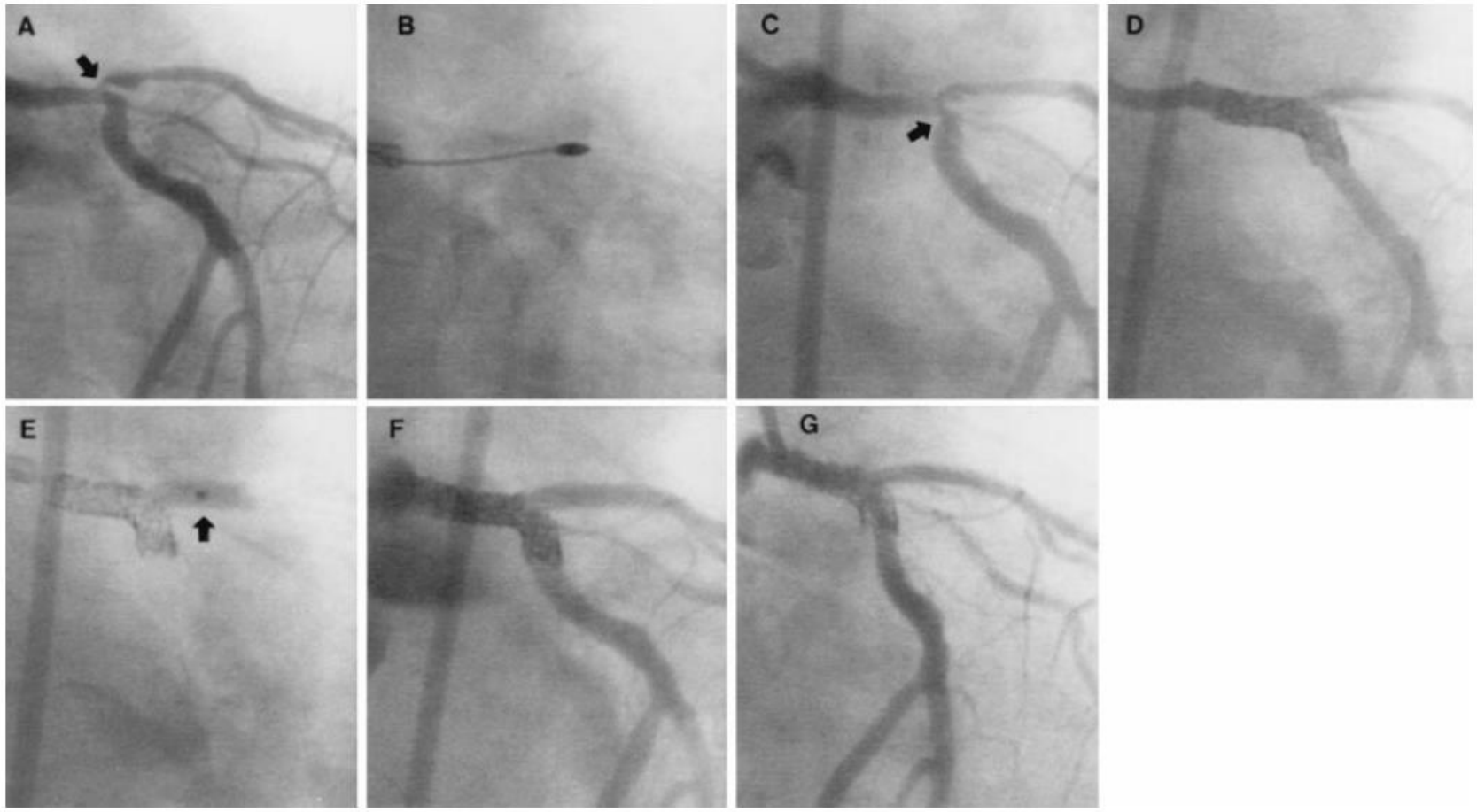
Background. **Left main coronary artery disease is regarded as an absolute contraindication for coronary angioplasty. Recently, several reports on protected or unprotected LMCA stenting, or both, suggested the possibility of percutaneous intervention for this prohibited area.**

Methods. **Forty-two consecutive patients with unprotected LMCA stenoses and normal LV function were treated with stents. The post-stent antithrombotic regimens were aspirin and ticlopidine; 14 patients also received warfarin. Patients were followed very closely with monthly telephone interviews and follow-up angiography at 6 months.**

Results. **The procedural success rate was 100%, with no episodes of subacute thrombosis regardless of anticoagulation regimen. Six-month follow-up angiography was performed in 32 of 34 eligible patients. Angiographic restenosis occurred in seven patients (22%, 95% confidence interval 7% to 37%); five patients subsequently underwent elective coronary artery bypass graft surgery (CABG), and two patients were treated with rotational atherectomy plus adjunct balloon angioplasty. The only death occurred 2 days after elective CABG for treatment of in-stent restenosis. The other patients (without angiographic follow-up) remain asymptomatic.**

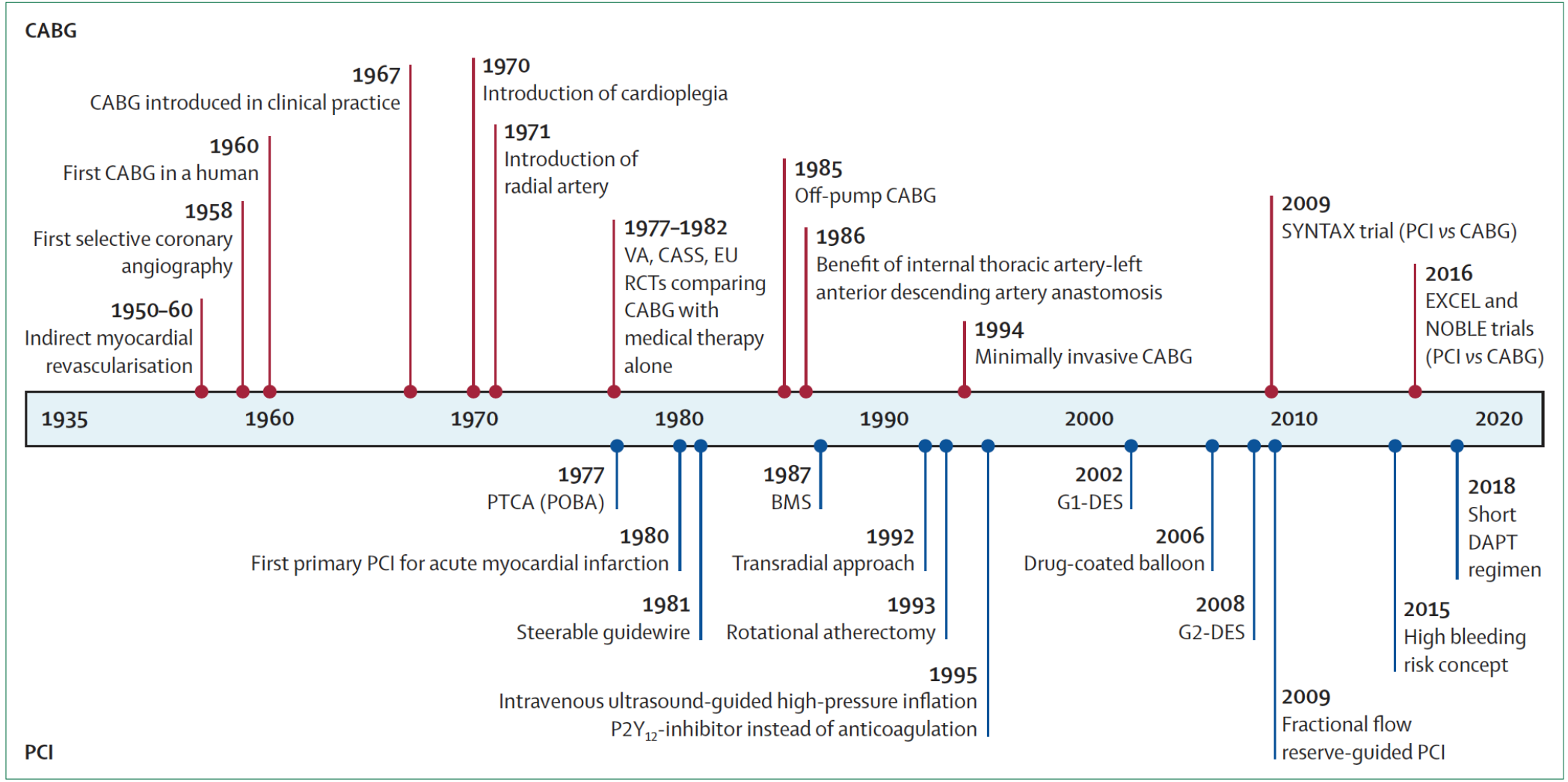
Conclusions. **Stenting of unprotected LMCA stenoses may be a safe and effective alternative to CABG in carefully selected patients with normal LV function. Further studies in larger patient populations are needed to assess late outcome.**

(J Am Coll Cardiol 1998;31:37–42)



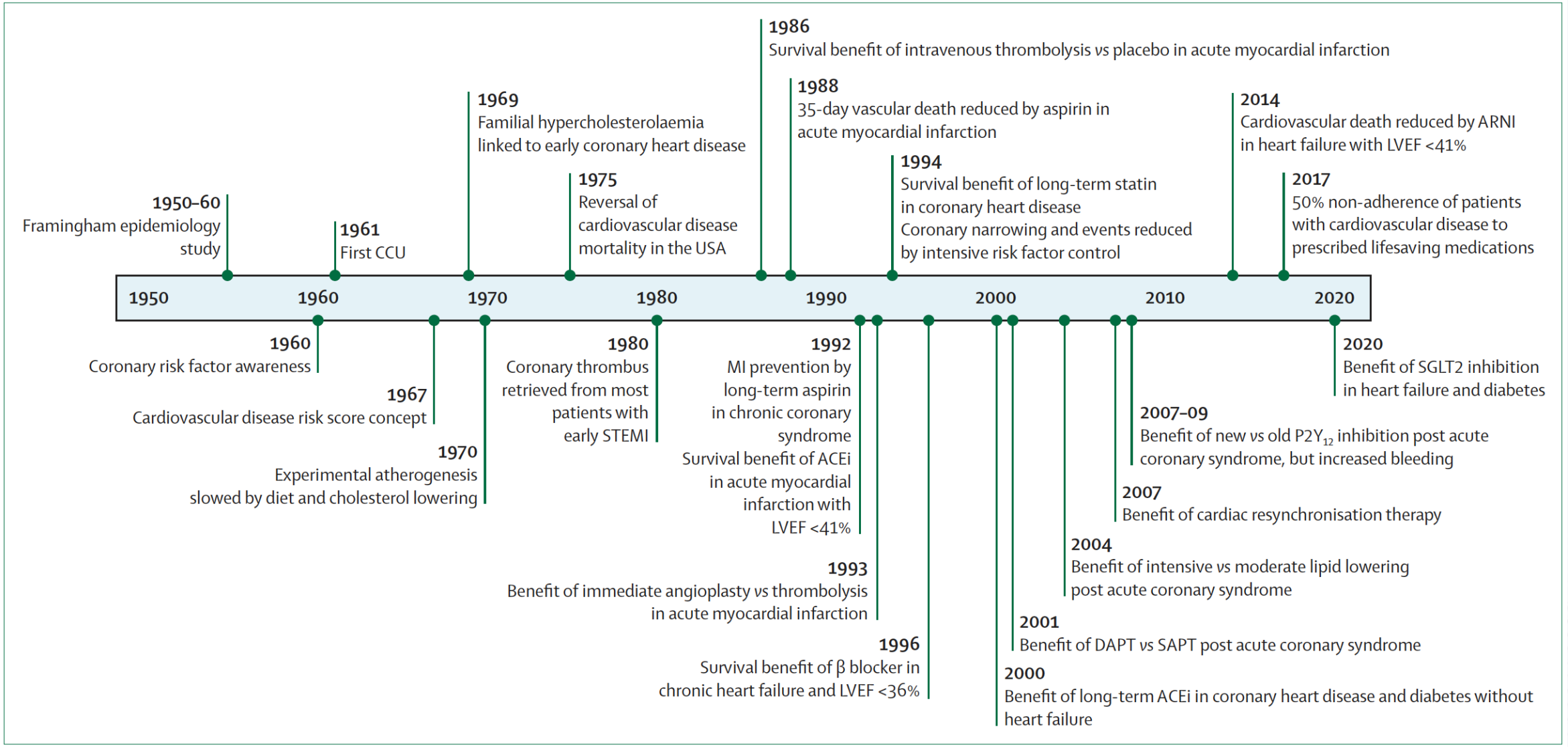
Rotablation and Palmaz-Schatz stent

Timeline of key advancements in surgical and percutaneous coronary revascularization

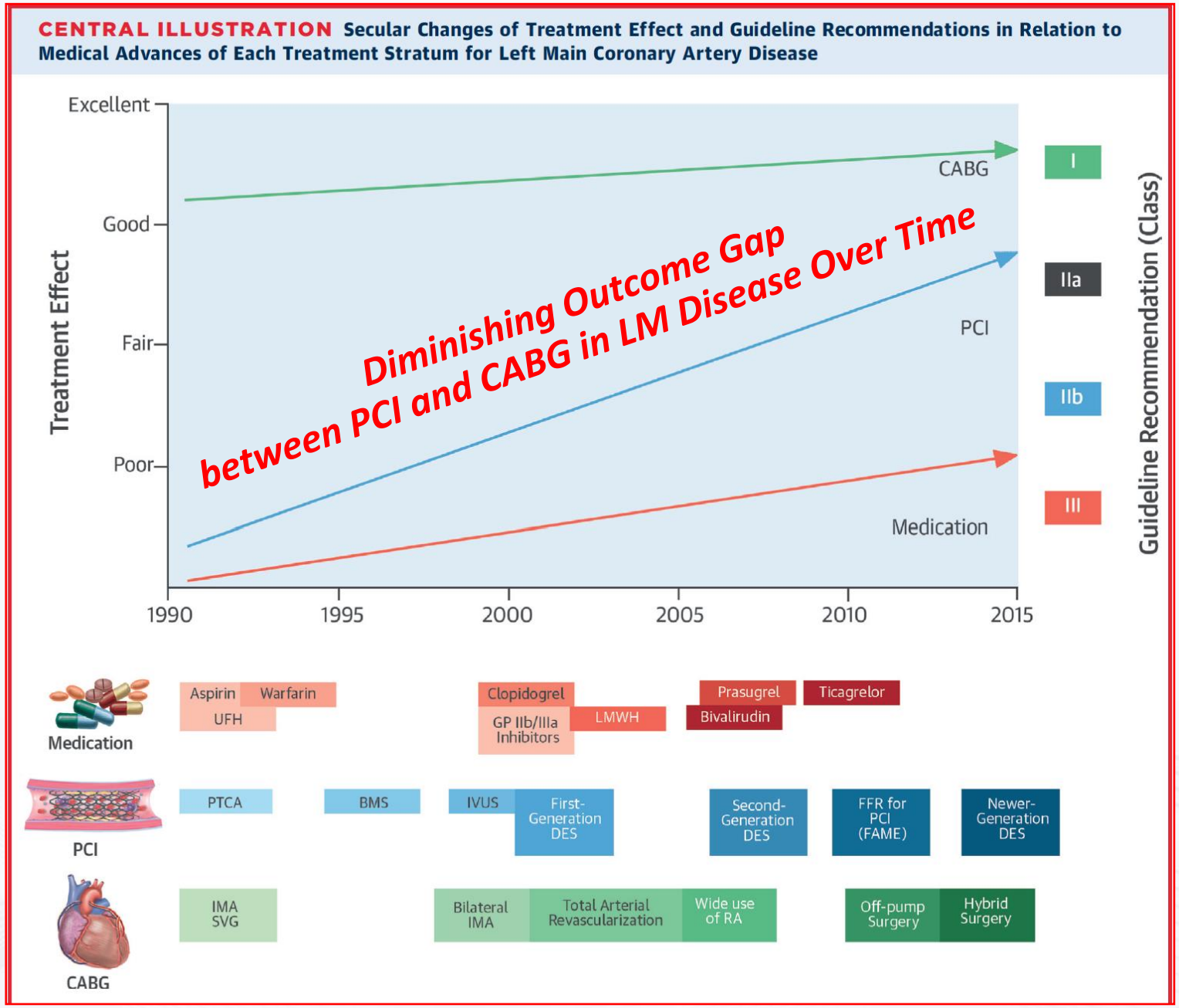


Mario Gaudino, et al. Lancet 2023; 401: 1611–2

Timeline of key advancements in medical therapy for coronary artery disease



Mario Gaudino, et al. Lancet 2023; 401: 1611–2



Park DW, Park SJ et al. JACC 2016;68:233-46

PCI vs. CABG
for LM Disease

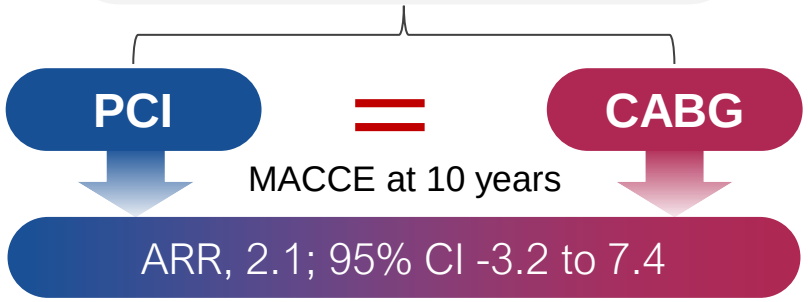
Recent Data

PCI vs. CABG for LM Disease

1. SYNTAX 10 years (n=1,800)
2. PRECOMBAT 10 years (n=600)
3. NOBLE 5 Year (n=1,200)
4. EXCEL 5 Year (n=1,900)
5. Combined Patient Level Meta-Analysis, 2021

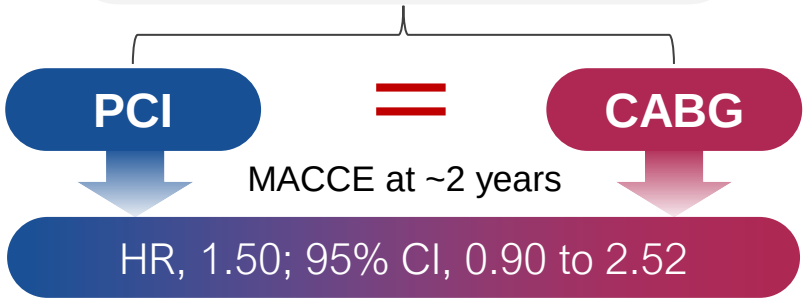
PCI vs. CABG for left main disease

SYNTAX-LM



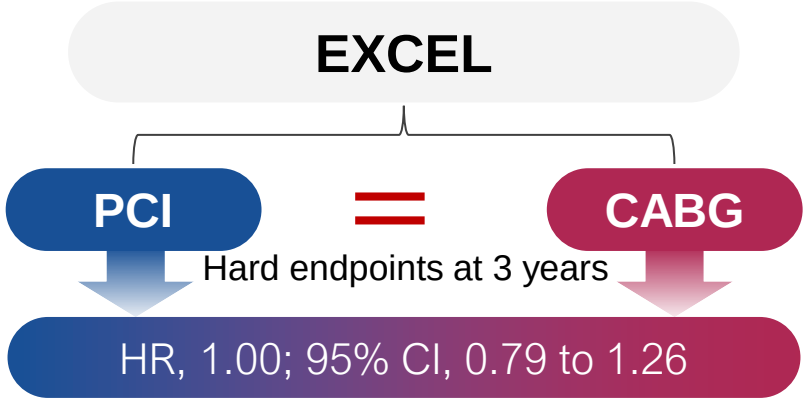
Circulation. 2010;121:2645-2653

PRECOMBAT



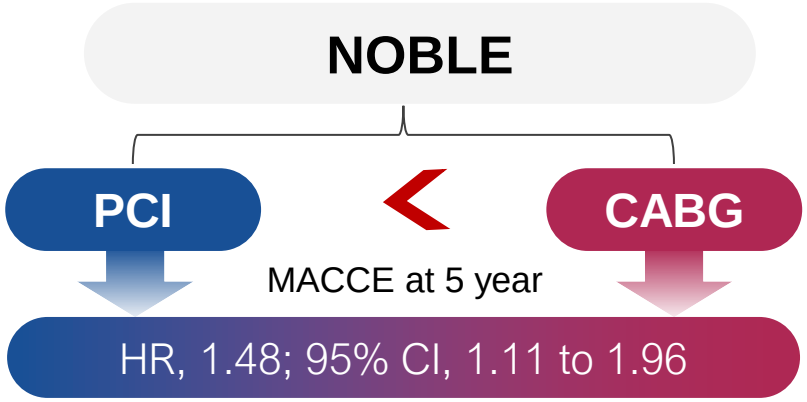
N Engl J Med 2011;364:1718-27

EXCEL



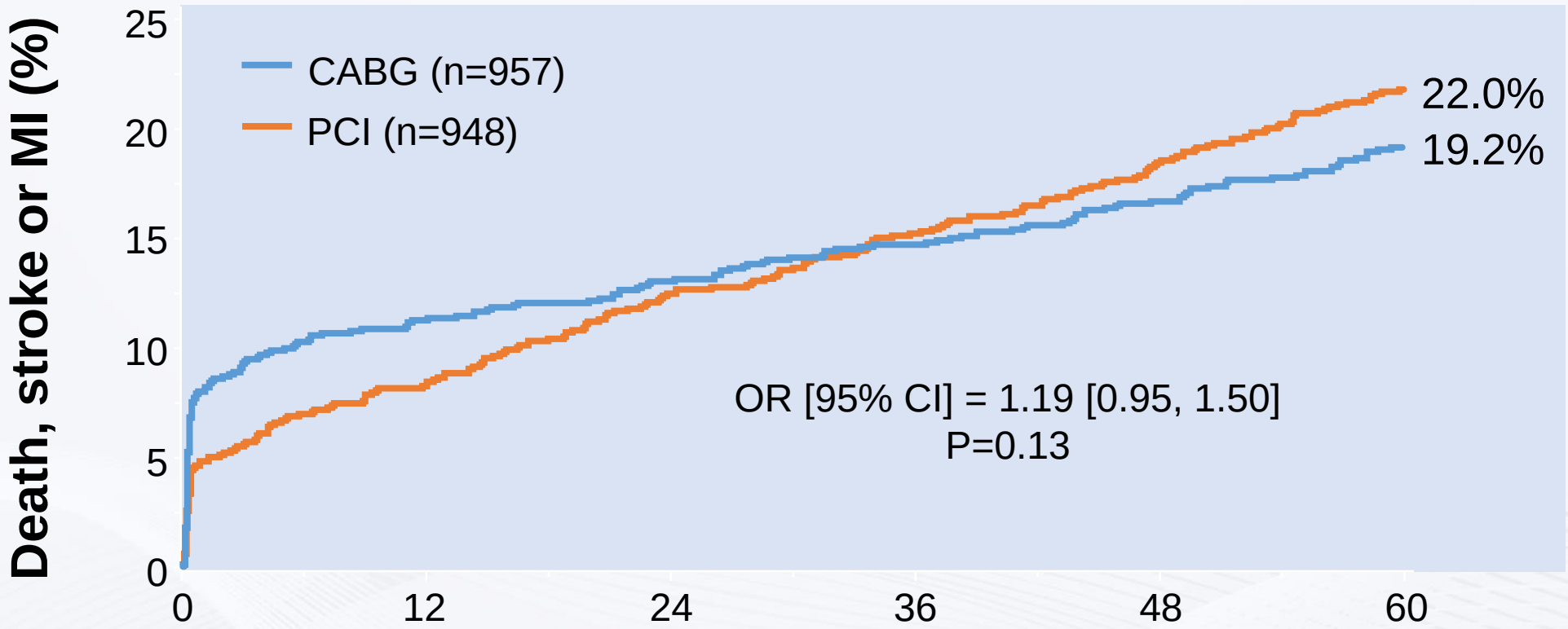
N Engl J Med 2016;375:2223-2235

NOBLE



Lancet 2016; 388):2743-2752

Primary Endpoint at EXCEL 5-year
(All-cause Death, Stroke or MI)



P=NS

Stone GW et al. NEJM 2019:Sept 28th, on-line

Secondary Clinical Endpoint at EXCEL 5-year

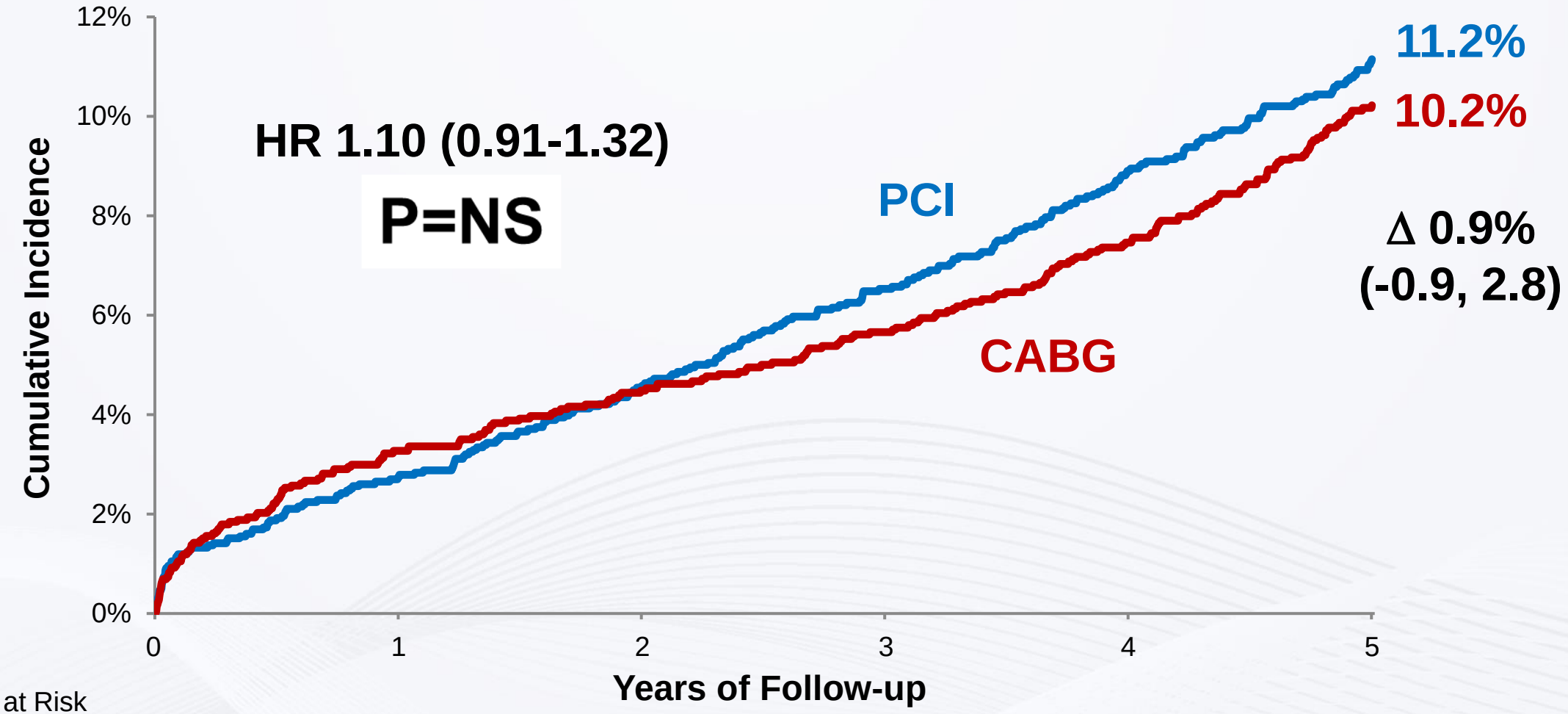
	PCI (N=948)	CABG (N=957)	Difference [95% CI]	Odds ratio [95% CI]
Death, stroke or MI	**22.0% (203)**	**19.2% (176)**	**2.8% [-0.9%, 6.5%]**	**1.19 [0.95, 1.50]**
Death, all-cause	13.0% (119)	9.9% (89)	3.1% [0.2%, 6.1%]	1.38 [1.03, 1.85]
- Cardiovascular	6.8% (61)	5.5% (49)	1.3% [-0.9%, 3.6%]	1.26 [0.85, 1.85]
- Definite cardiovascular	5.0% (45)	4.5% (40)	0.5% [-1.4%, 2.5%]	1.13 [0.73, 1.74]
- Undetermined cause	1.9% (16)	1.1% (9)	0.9% [-0.3%, 2.0%]	1.78 [0.78, 4.06]
- Non-cardiovascular	6.6% (58)	4.6% (40)	2.0% [-0.2%, 4.2%]	1.47 [0.97, 2.23]
Cerebrovascular events	3.3% (29)	5.2% (46)	-1.9% [-3.8%, 0.0%]	0.61 [0.38, 0.99]
- Stroke	2.9% (26)	3.7% (33)	-0.8% [-2.4%, 0.9%]	0.78 [0.46, 1.31]
- Transient ischemic attack	0.3% (3)	1.6% (14)	-1.3% [-2.2%, -0.4%]	0.21 [0.06, 0.74]
Myocardial infarction	10.6% (95)	9.1% (84)	11.4% [-1.3%, 4.2%]	1.14 [0.84, 1.55]
- Peri-procedural	3.9% (37)	6.1% (57)	-2.1% [-4.1%, -0.1%]	0.63 [0.41, 0.96]
- Non-peri-procedural	6.8% (59)	3.5% (31)	3.2% [1.2%, 5.3%]	1.96 [1.25, 3.06]

Meta-Analysis of 4 Randomized Trials SYNTAX, PRECOMBAT, NOBLE, and EXCEL

4394 patients, were randomly assigned to PCI (n=2197) or CABG (n=2197) with a median SYNTAX score of 25·0 (IQR 18·0-31·0)

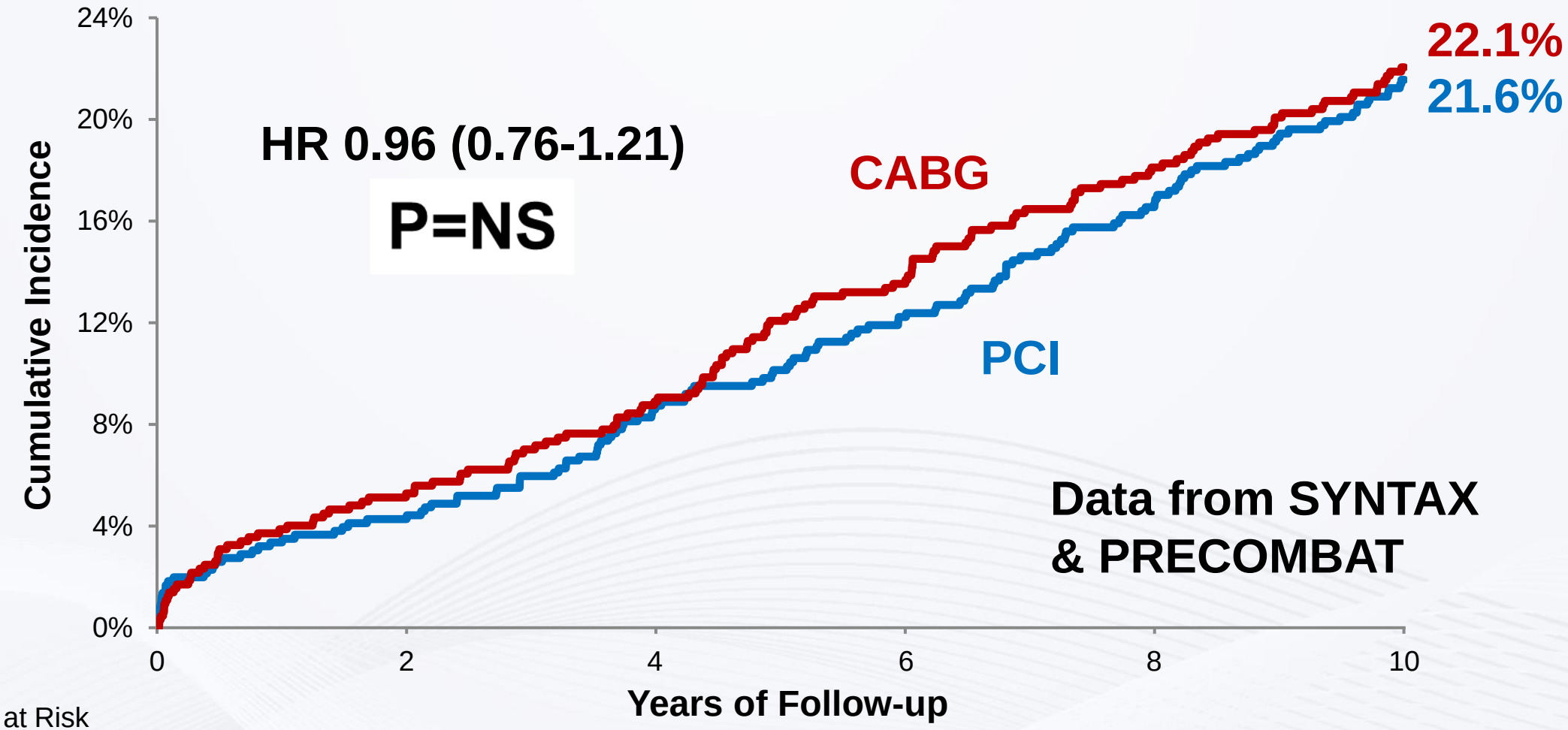
Sabatine MS et al. Lancet 2021;398:2247-57

All Death at 5-Year (4 trials)



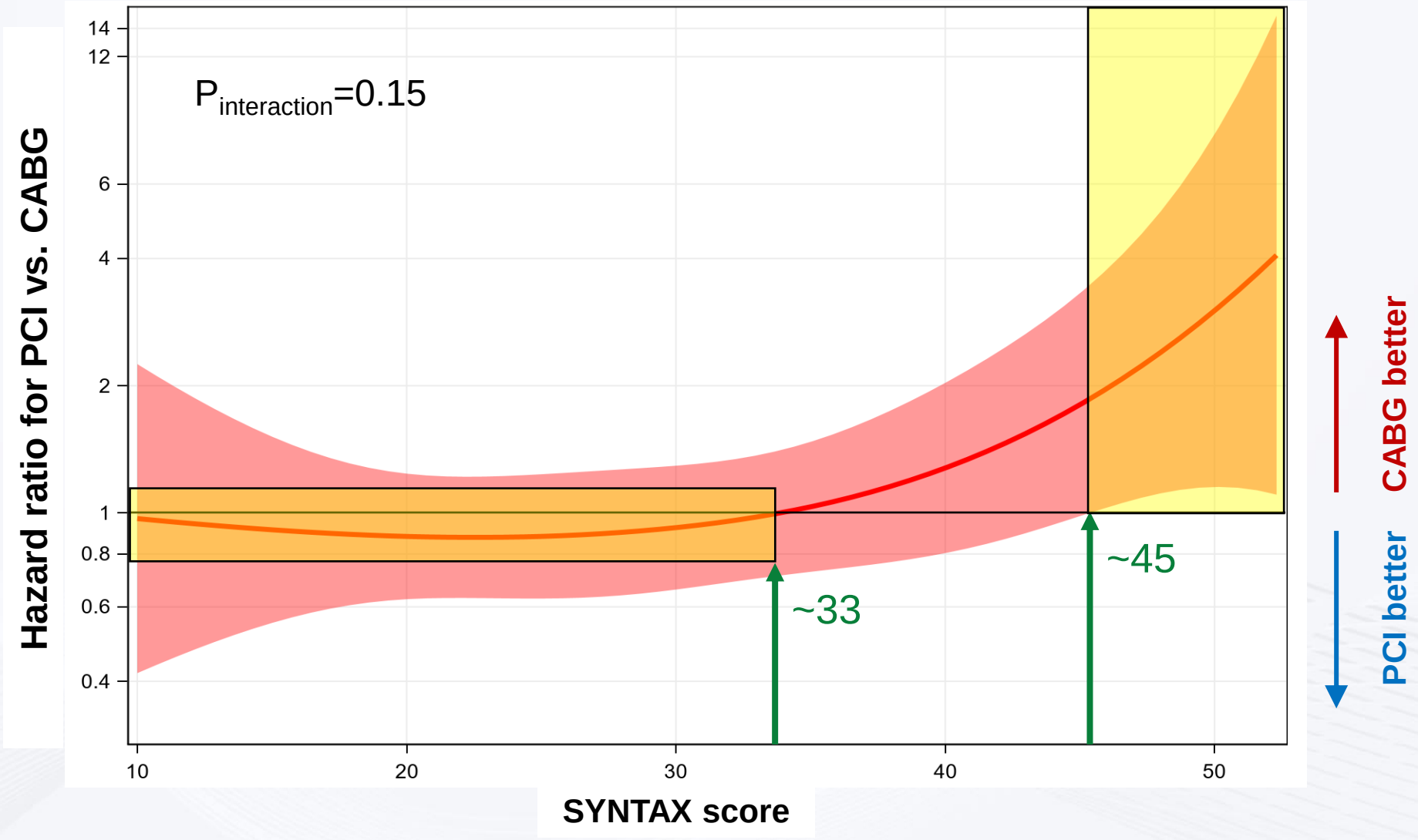
Number at Risk						
CABG	2197	2085	2042	2002	1939	1585
PCI	2197	2120	2068	2015	1942	1539

All Death at 10-Year (2 trials)



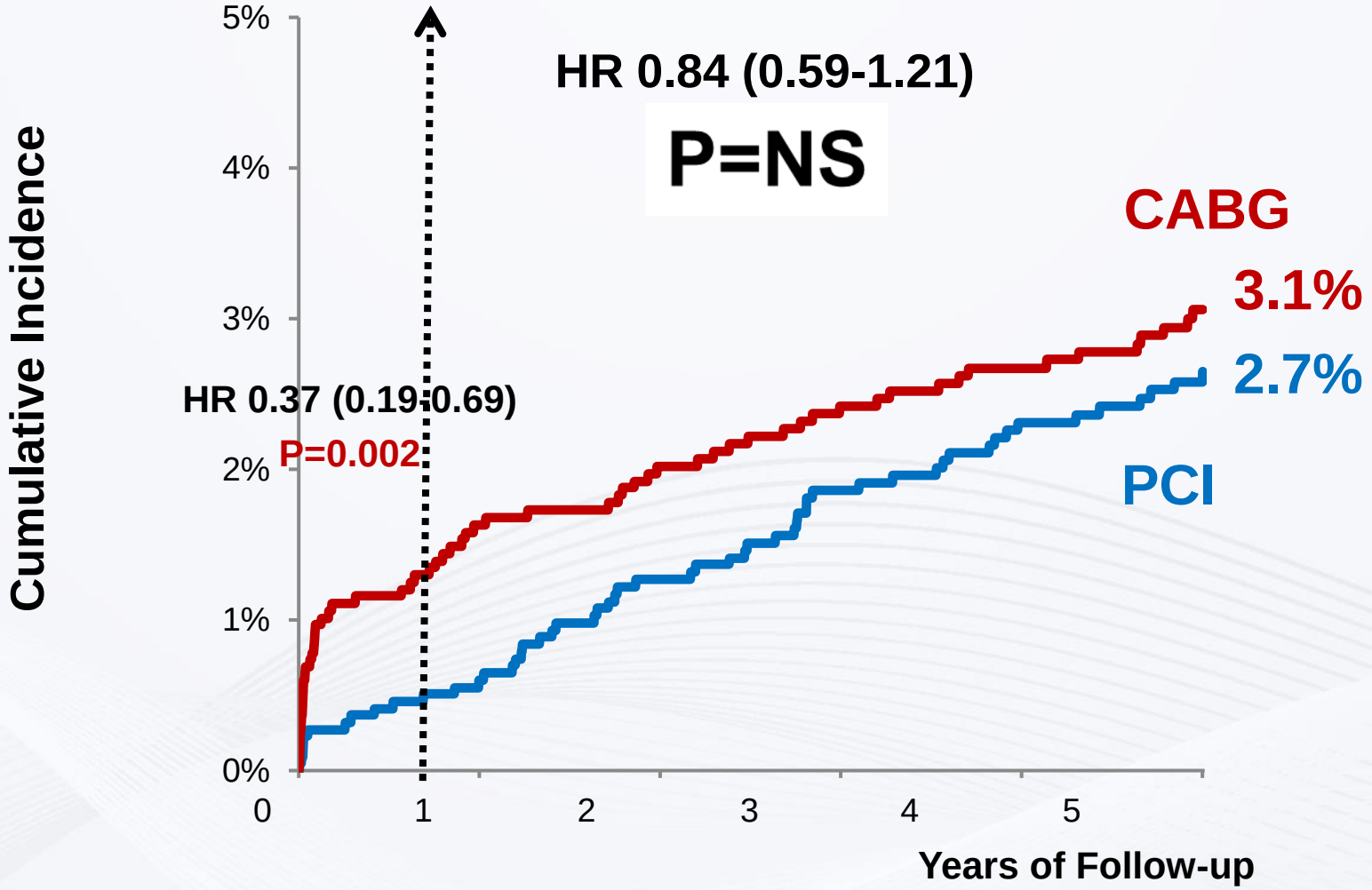
Number at Risk						
CABG	648	604	577	531	500	463
PCI	657	623	591	547	519	475

CV Mortality and SYNTAX Score: Spline analysis



Sabatine MS et al. Lancet 2021;398:2247-57

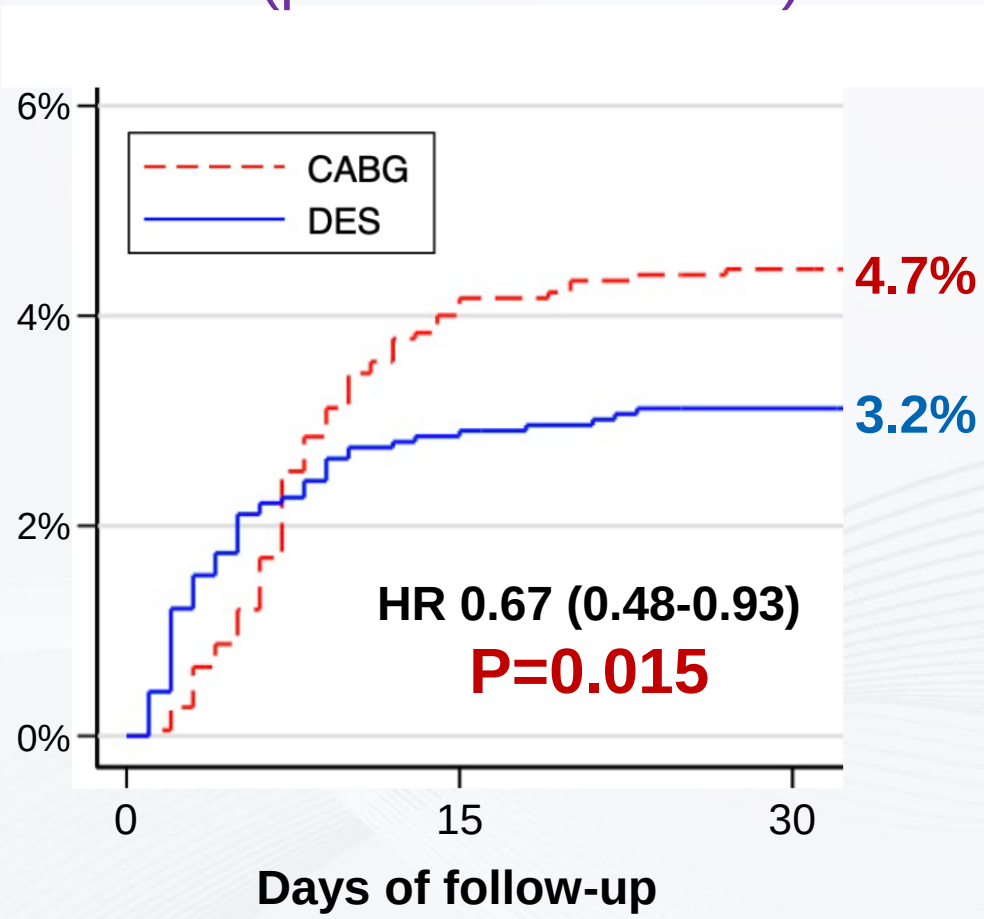
Stroke at 5-year



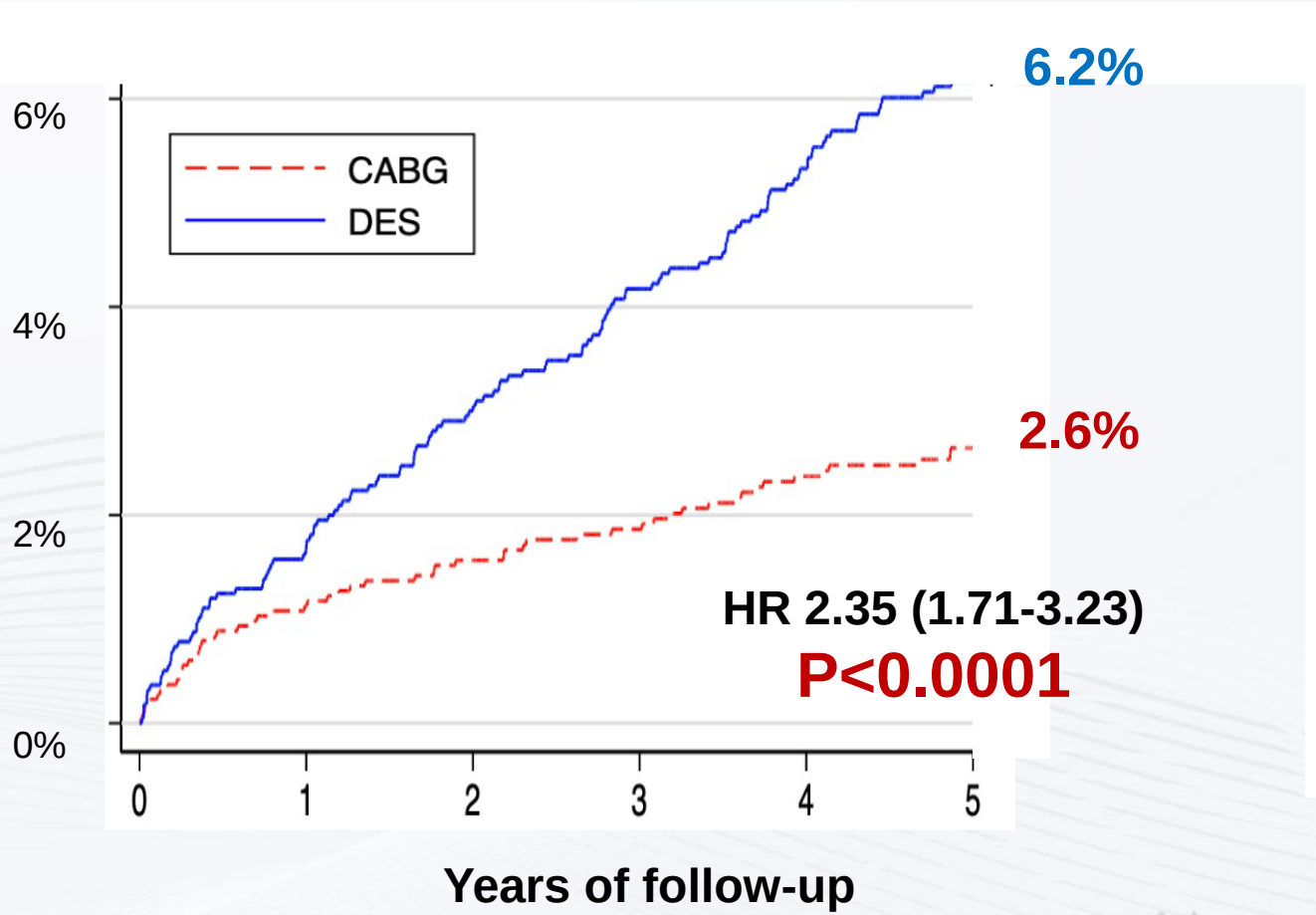
Sabatine MS et al. Lancet 2021;398:2247-57

Procedural and Spontaneous MI at 5-year

Procedural MI
(protocol definition)



Spontaneous MI



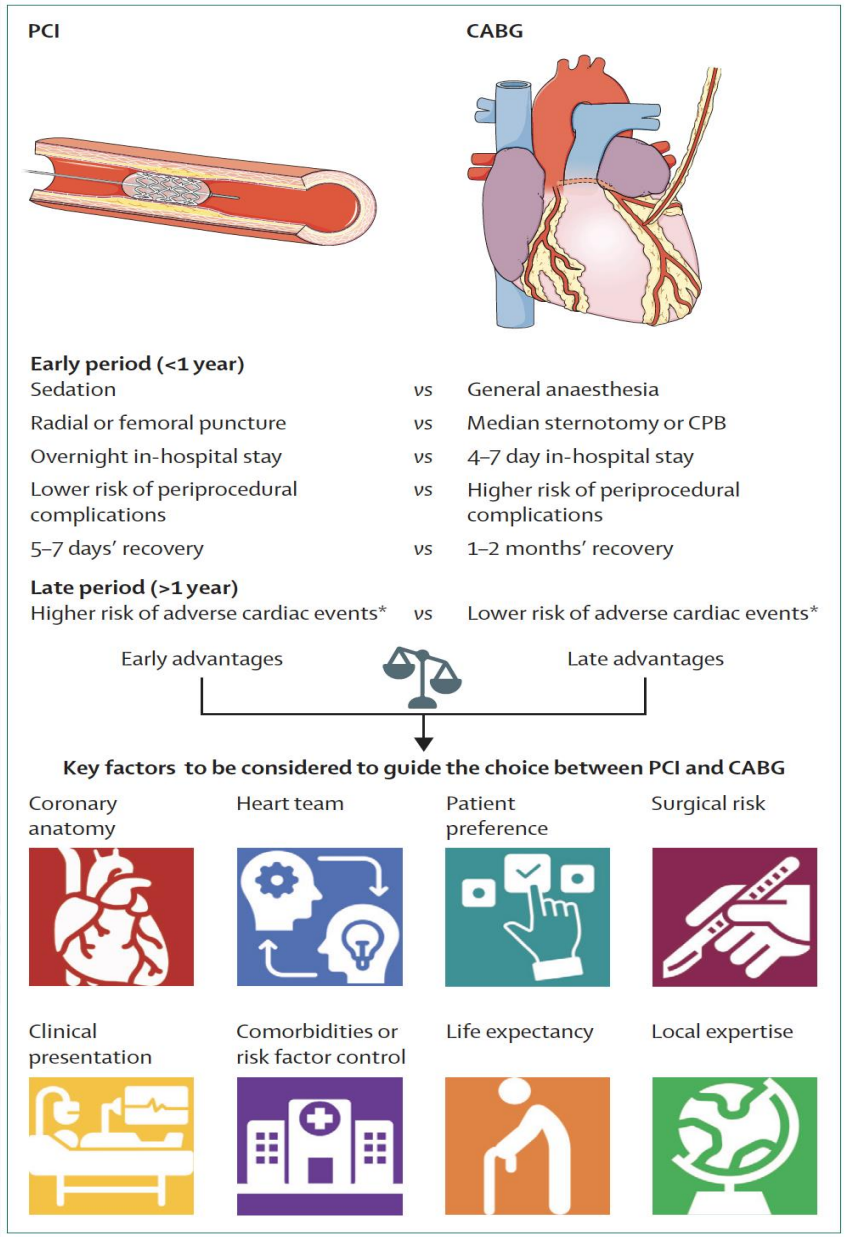
Sabatine MS et al. Lancet 2021;398:2247-57

Key Summary

PCI vs. CABG for Left Main Disease

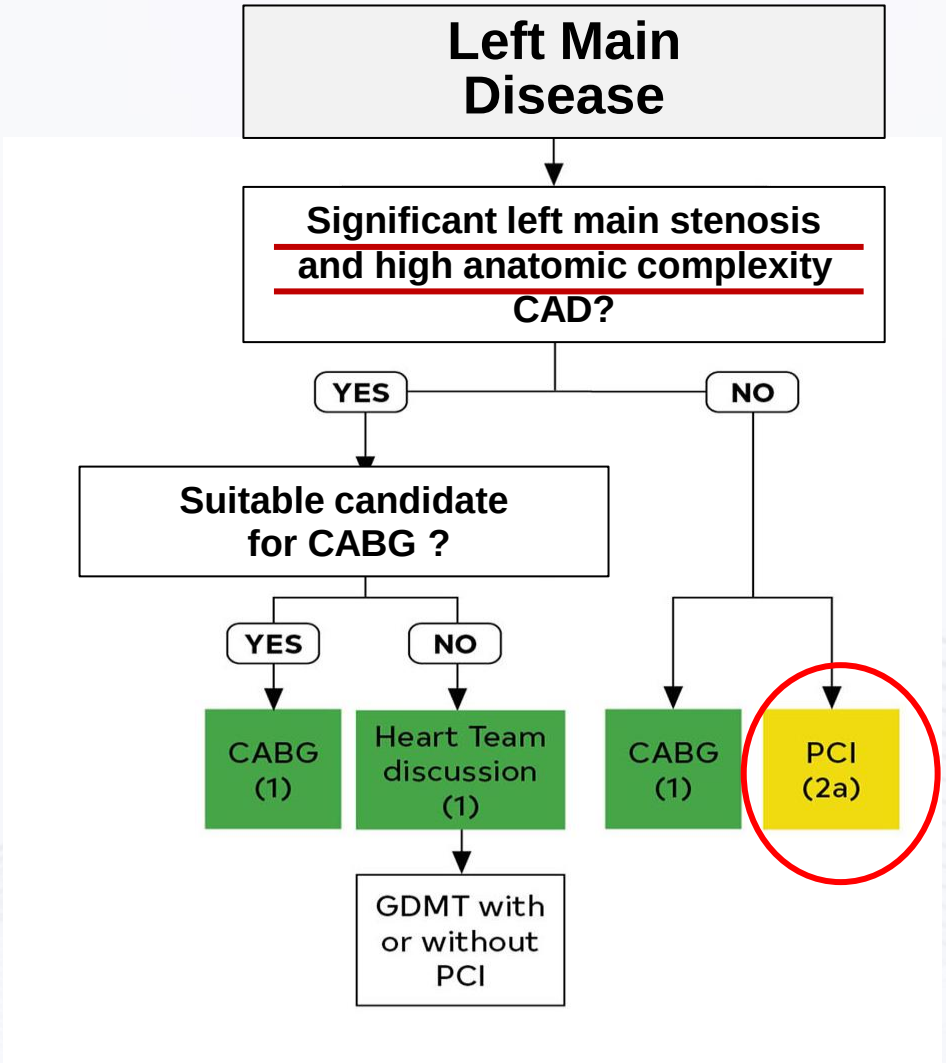
1. ***No Mortality Difference !***
2. ***PCI* Has *Lower Peri-procedural Complications***
   (stroke, large MI, atrial fibrillation, bleeding, AKI, etc)
3. ***CABG* Has *Lower* Spontaneous MI and Repeat revascularization**

Comparison of key aspects of CABG or PCI



Mario Gaudino, et al. Lancet 2023; 401: 1611–2

2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



Jennifer S. Lawton. Circulation. 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization:

ESC Guidelines 2018
Elective PCI for LM Stenosis

	CABG		PCI	
Recommendation according to extent of CAD	**Class**	**Level**	**Class**	**Level**
LM disease a SYNTAX score ≤ 22	**I**	**A**	**I**	**A**
LM disease a SYNTAX score 23 -32	**I**	**A**	**IIa**	**A**
LM disease a SYNTAX score > 32	**I**	**A**	**III**	**B**

Reference; SYNTAX Study, PRECOMBAT study, MAINCOMPARE registry study and Meta-Analysis. *Patrick, SW et al, NEJM. 2009 March 5;360(10), Park SJ et al, NEJM. 2011 May 5;364(18):1718-27, Levin GN et al. ACC/AHA guidelines. JACC 2011;58:44-122, Capodanno et al, JACC 2011;58:1426-32*

ESC/EACTS Task Force Recommends Downgrading PCI in Left Main CAD

For those with LM CAD and a low SYNTAX score, PCI should be no longer be a class I recommendation, the group says.

by Michael O'Riordan | SEPTEMBER 05, 2023

AMSTERDAM, the Netherlands—A new task force is recommending that PCI for the treatment of left main CAD in patients at low surgical risk be downgraded from its current place in the European revascularization guidelines.

ESC European Society of Cardiology

European Heart Journal (2023) **00**, 1–11
https://doi.org/10.1093/eurheartj/ehad476

SPECIAL ARTICLE
Interventional cardiology

2022 Joint ESC/EACTS review of the 2018 guideline recommendations on the revascularization of left main coronary artery disease in patients at low surgical risk and anatomy suitable for PCI or CABG

Robert A. Byrne [1,2*†], Stephen Fremes [3,4*†], Davide Capodanno [5], Martin Czerny [6,7], Torsten Doenst[8], Jonathan R. Emberson [9], Volkmar Falk[10,11,12,13], Mario Gaudino [14], John J. V. McMurray [15], Roxana Mehran [16], Milan Milojevic [17,18], and Miguel Sousa Uva [19,20]

Eur Heart J. 2023 Aug 26:ehad476. doi: 10.1093/eurheartj/ehad476.

Graphical Abstract

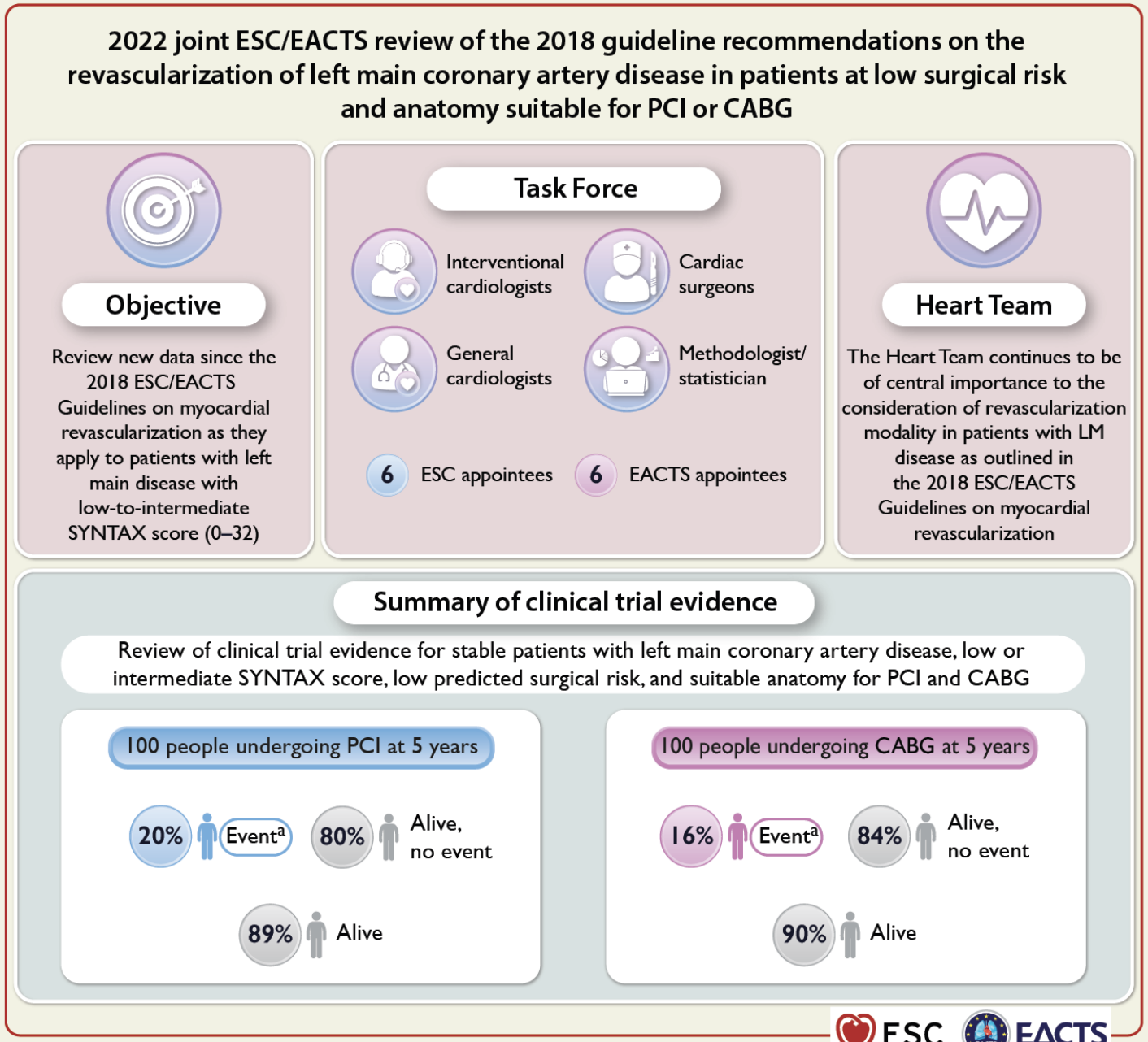


Table 1 **Suggested recommendation for type of revascularization in stable patients with left main disease, coronary anatomy suitable for both procedures and low predicted surgical mortality**

Recommendation	CABG		PCI	
	Class[a]	Level[b]	Class[a]	Level[b]
Left main disease with low or intermediate SYNTAX score (0–32).	I	A	IIa	A

CABG, coronary artery bypass graft; PCI, percutaneous coronary intervention; SYNTAX, Synergy Between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery.

[a]Class of recommendation.

[b]Level of evidence.

Eur Heart J. 2023 Aug 26:ehad476. doi: 10.1093/eurheartj/ehad476.

Table 2 **Practical recommendation and clinical situations favouring percutaneous coronary intervention or coronary artery bypass grafting in patients with left main disease**

		Favours PCI	Favours CABG
Clinical characteristics	Advanced age/frailty/reduced life expectancy	✓	
	Severe co-morbidity (not adequately reflected by scores)	✓	
	High surgical risk	✓	
	Reduced LVEF <35%		✓
	Diabetes		✓
	Contraindication for DAPT		✓
	Recurrent diffuse in-stent restenosis		✓
	Prior CABG with patent LIMA-LAD graft	✓	
Anatomical and Technical aspects	Ostial or mid-shaft lesion	✓	
	Distal or bifurcation lesion		✓
	Presence of multivessel disease		✓
	High anatomic complexity (e.g. SYNTAX score >32)		✓
	Anatomy likely resulting in incomplete revascularization with PCI		✓
	Occluded dominant graftable right coronary artery		✓
	Severely calcified coronary artery lesions limiting lesion expansion		✓
	Sequelae of chest radiation	✓	
	Severe chest deformity	✓	
	Porcelain aorta (if local expertise with OPCAB with anaortic grafting not available)	✓	
	Need for concomitant cardiac surgery or surgery of ascending aorta		✓

My Real-World Practic Approach

PCI vs. CABG for Left Main Disease

If Extensive Non-LM CAD *is present*

CABG may be preferred

If Multiple Comorbidities *are present*

PCI may be preferred.

Guadino M, Farkouh ME, Stone GW, EHJ 2022:doi: 10.1093/eurheartj/ehac216 Online ahead of print.

Future Perspective on Left Main or Multivessel PCI

What Are Next Step?

DRIVING THE FUTURE of PRECISION MEDICINE

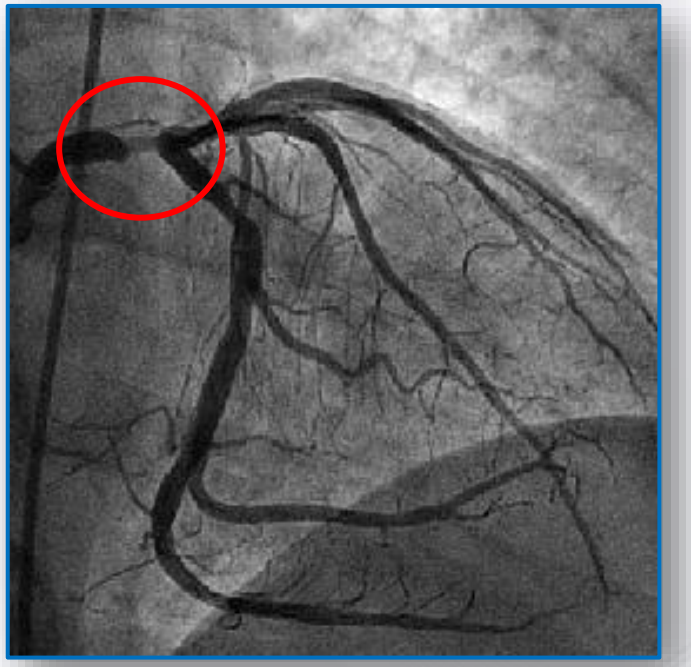
For LMCA PCI

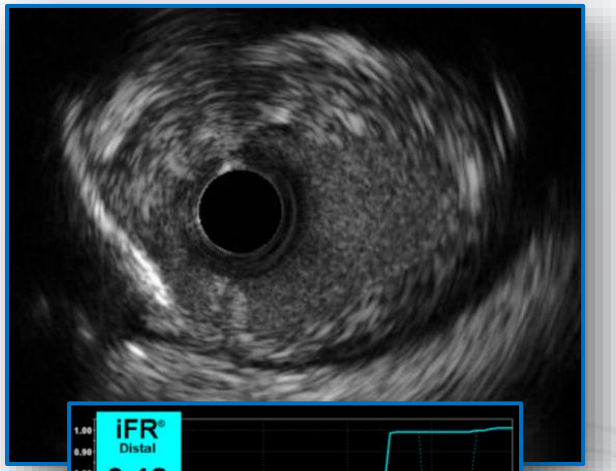
DIAGNOSIS

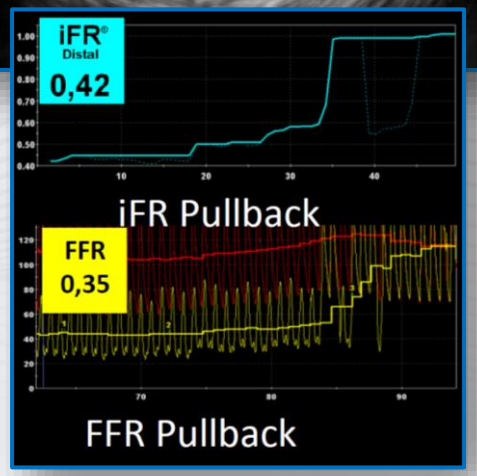
Assessment

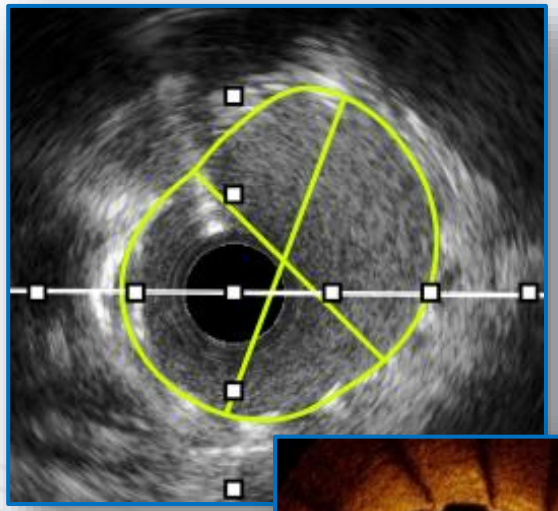
INTERVENTION

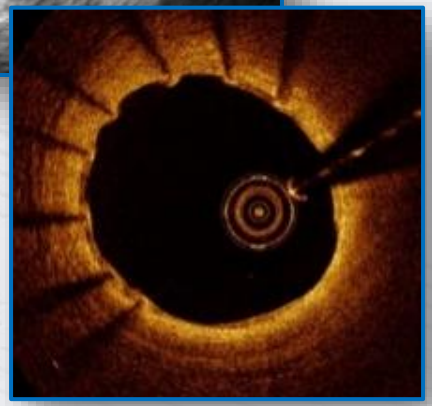
Guidance Optimization



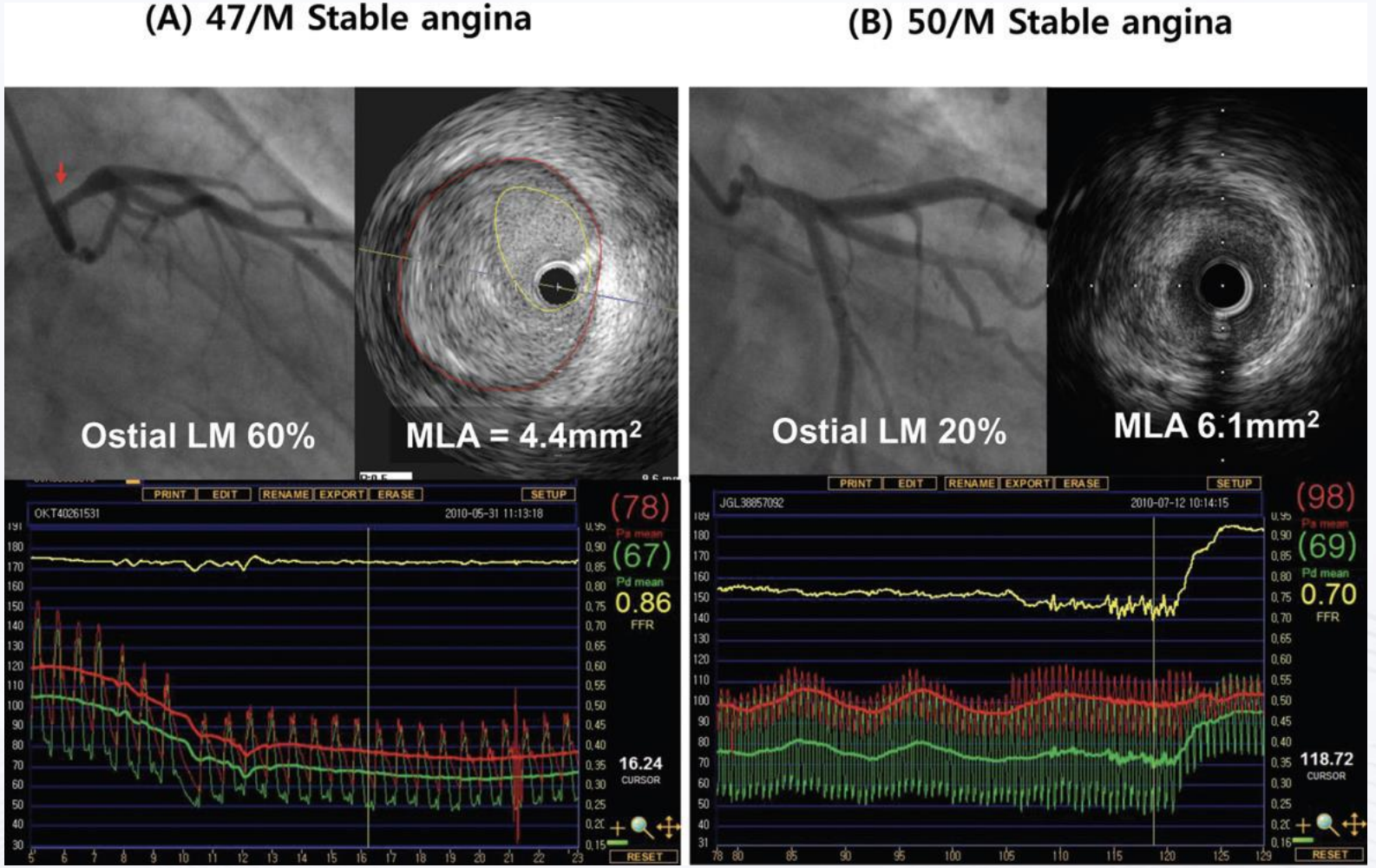








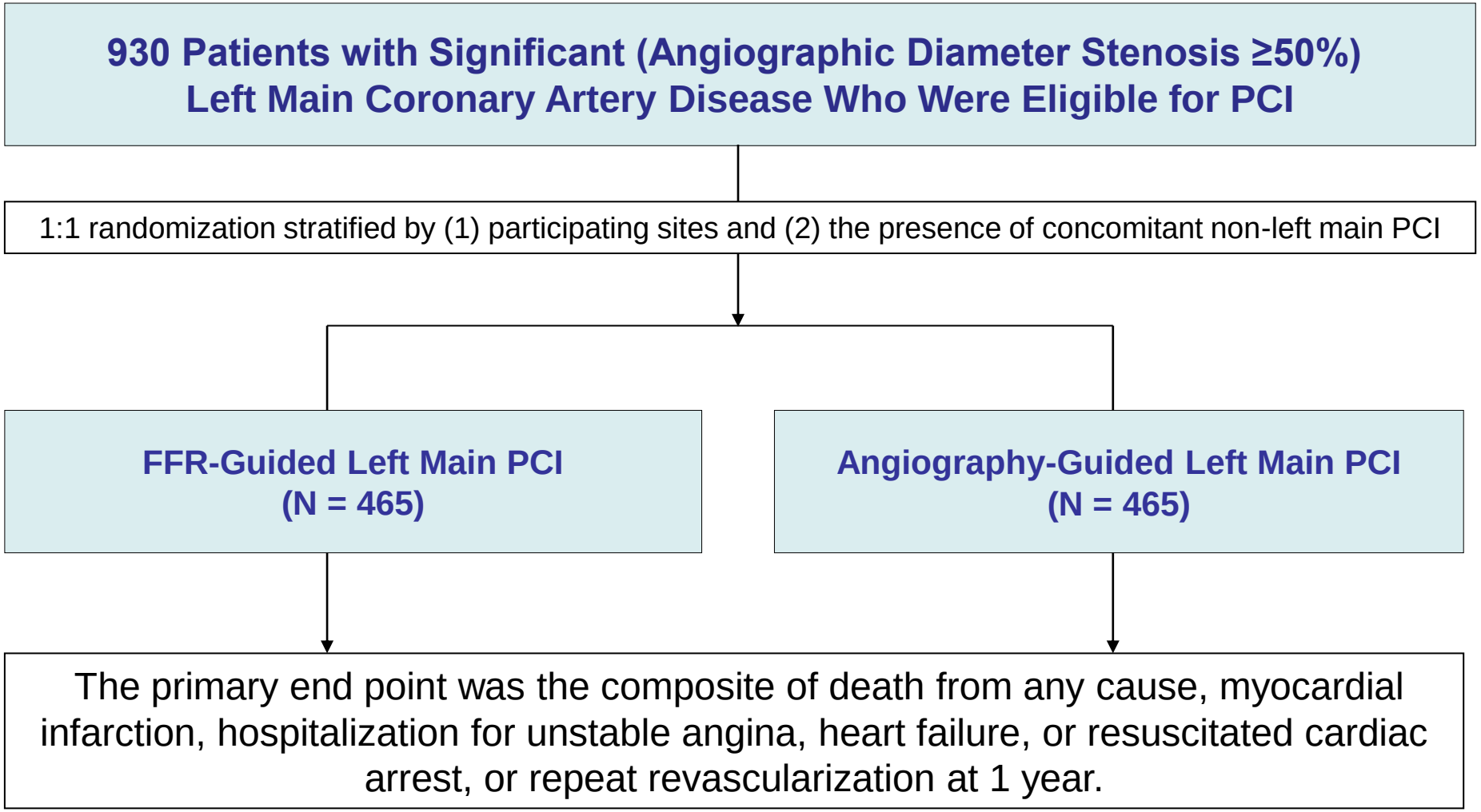
Representative case of visual–functional mismatch in LMCA stenosis



Park SJ et al. JAHA 2012 Dec;1(6):e004556

Fractional Flow Reserve versus Angiography for Treatment-Decision and Evaluation of Significant Left MAIN Coronary Artery Disease

FATE-MAIN Trial



Key Messages

- In the contemporary clinical practice, the goal of PCI is to achieve complete functional revascularization of ischemic territories. Thus, theoretical and practical concept of physiology-guided PCI will also work even in left main PCI setting.

- **In the FATE-MAIN trial,** we assume that the improved outcomes with FFR-guided PCI are likely a result of more judicious PCI whereby ischemia-inducing LMCA lesions are revascularized and non-ischemia-inducing LMCA lesions are treated with OMT alone.

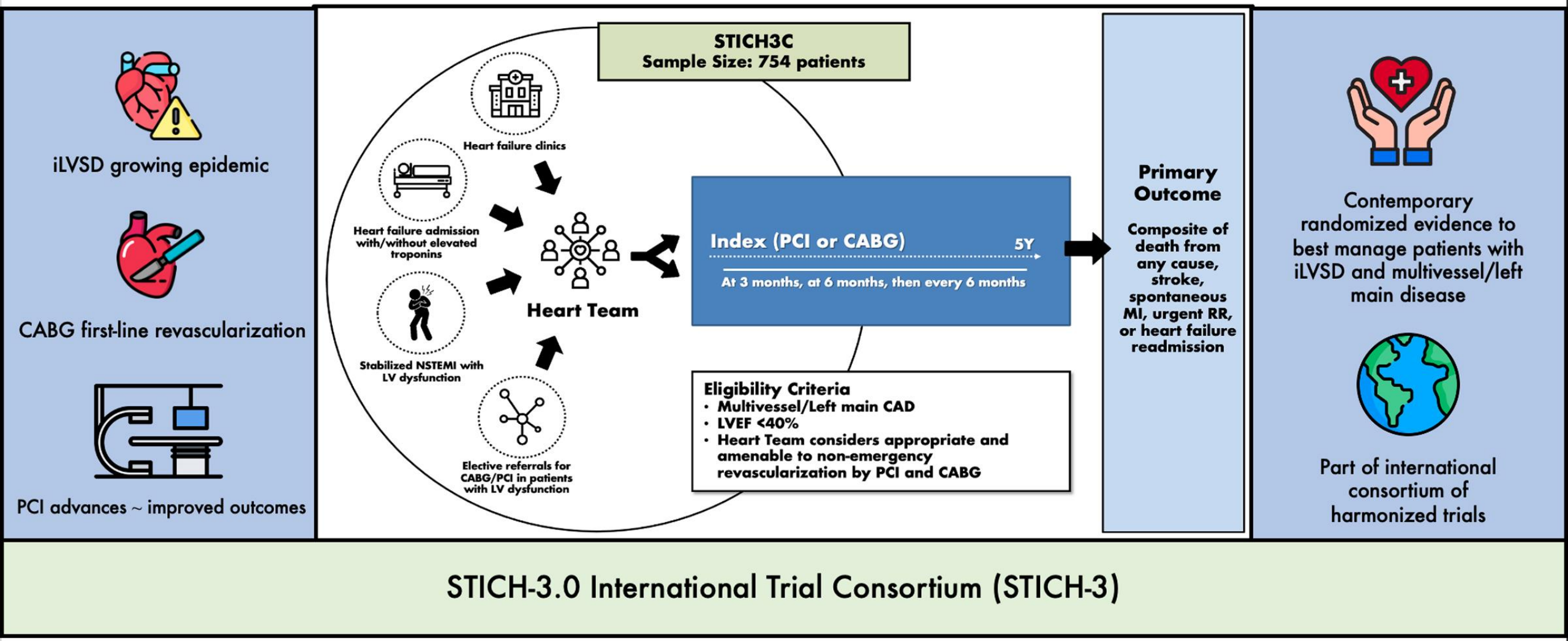
Still Remaining Issues, PCI vs. CABG

1. ***Contemporary PCI*** **vs. CABG for Multivessel Disease Patients with *Ischemic Cardiomyopathy (<50% EF).***

2. ***Contemporary PCI*** **vs. CABG for for Multivessel Disease Patients with *Diabetes.***

We Need More Data!

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. Aug;16(8):e012527.

Trial Design

Diabetes-Centered **E**valuation of **F**unctional and **I**maging-Combi**NE**d State-of-the-Art Percutaneous Coronary Intervention or Coronary-Artery Bypass Grafting in Patients with **D**iabetes **M**ellitus and Three-Vessel Coronary Artery Disease

DEFINE-DM Trial