LEFT MAIN DISEASE, When do we perform PCI or Surgery?

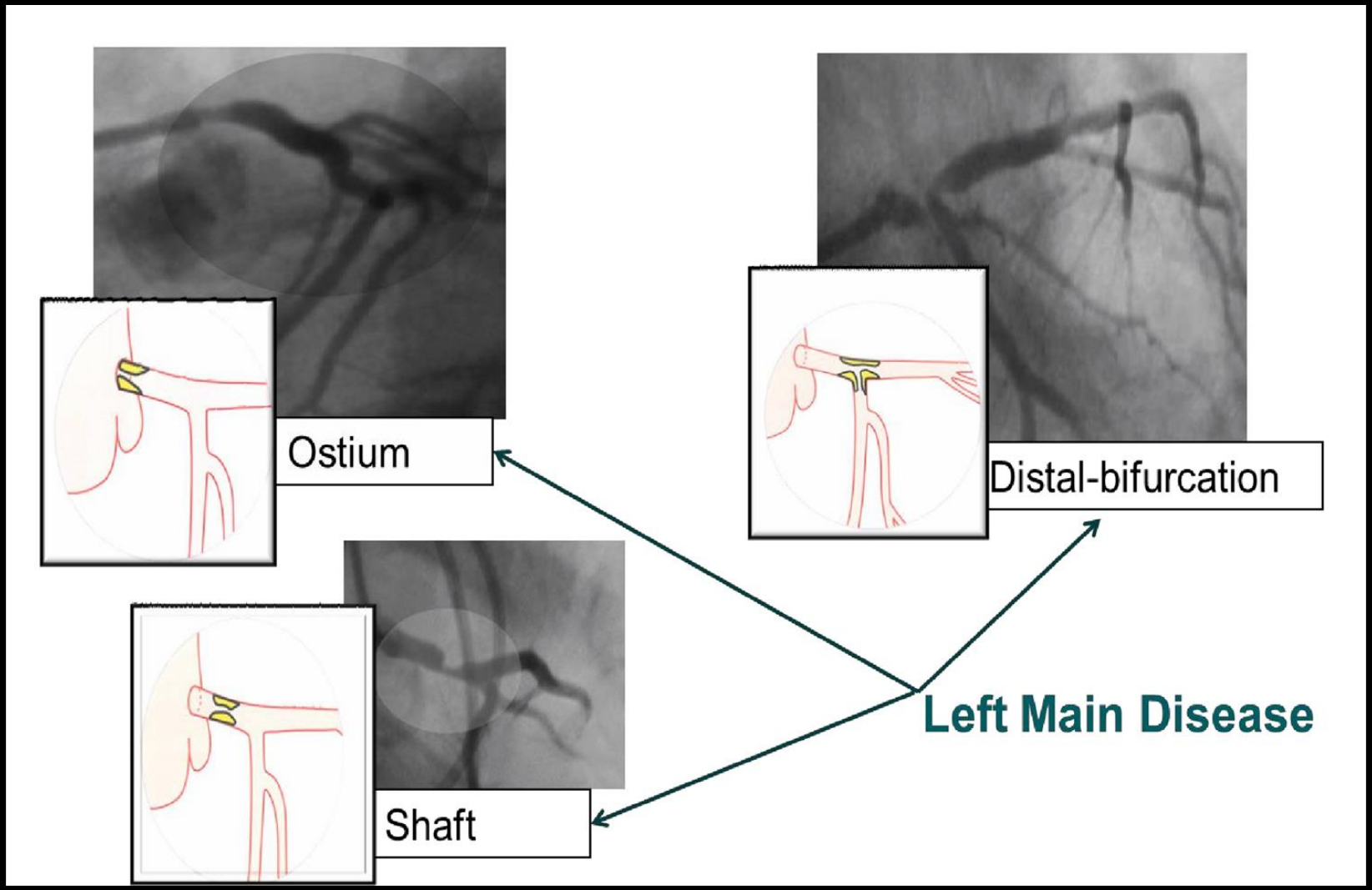
Nam Van Tran, MD
Intravascular intervention unit
Becamex International Hospital

BỆNH VIỆN QUỐC TẾ
BECAMEX
INTERNATIONAL HOSPITAL

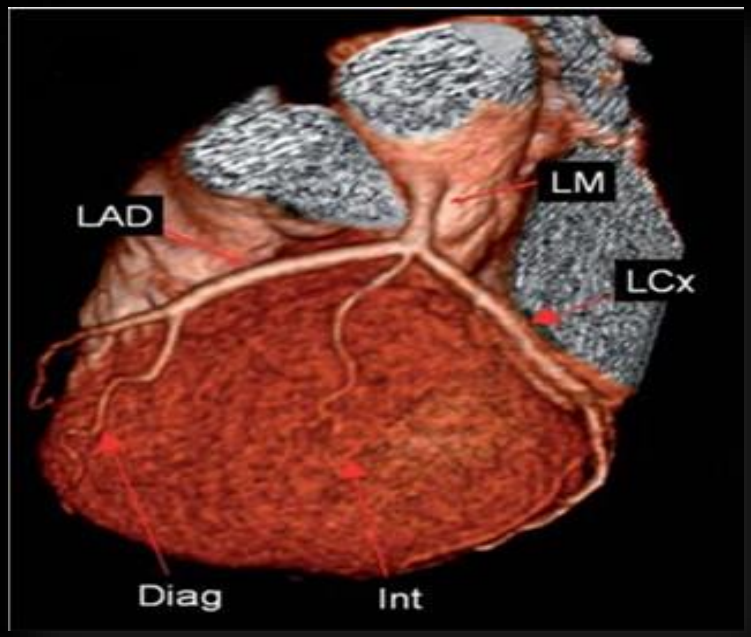
THE LEFT MAIN CORONARY ARTERY (LMCA)

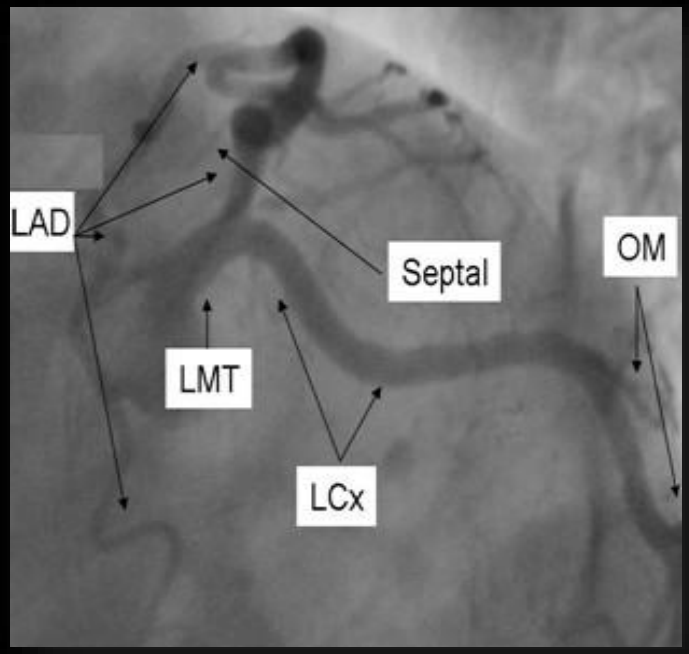
- LMCA disease is the highest-risk lesion subset of ischemic heart disease.
- The incidence of left main coronary artery stenosis is between 5% and 7%
- LMCA disease treated medically have 3-year mortality rate of 50%

Left Main Disease: Locations



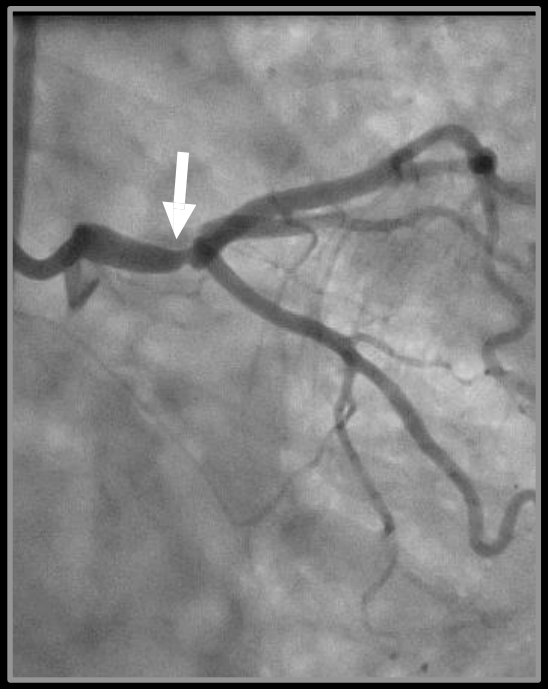
Why is the left main important?

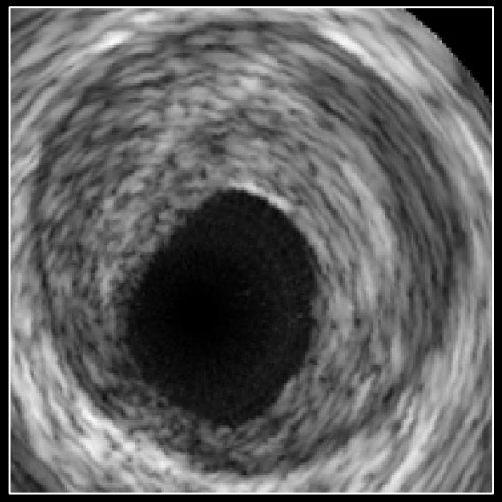


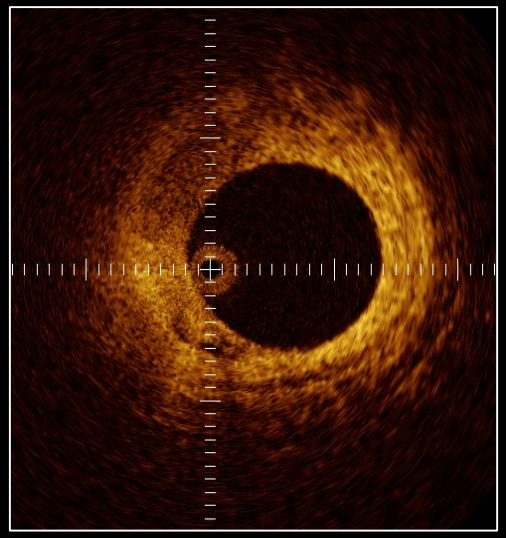


- It supplying at least 2/3 of the blood to the heart.
- Severe LMCA disease will reduce flow to a large portion of the myocardium.
- Stenosis of 50 to 70% : 3-year survival of 66%
- Stenosis of 70% : 3-year survival of 41%

Left Main assessment: *Imaging Modalities*







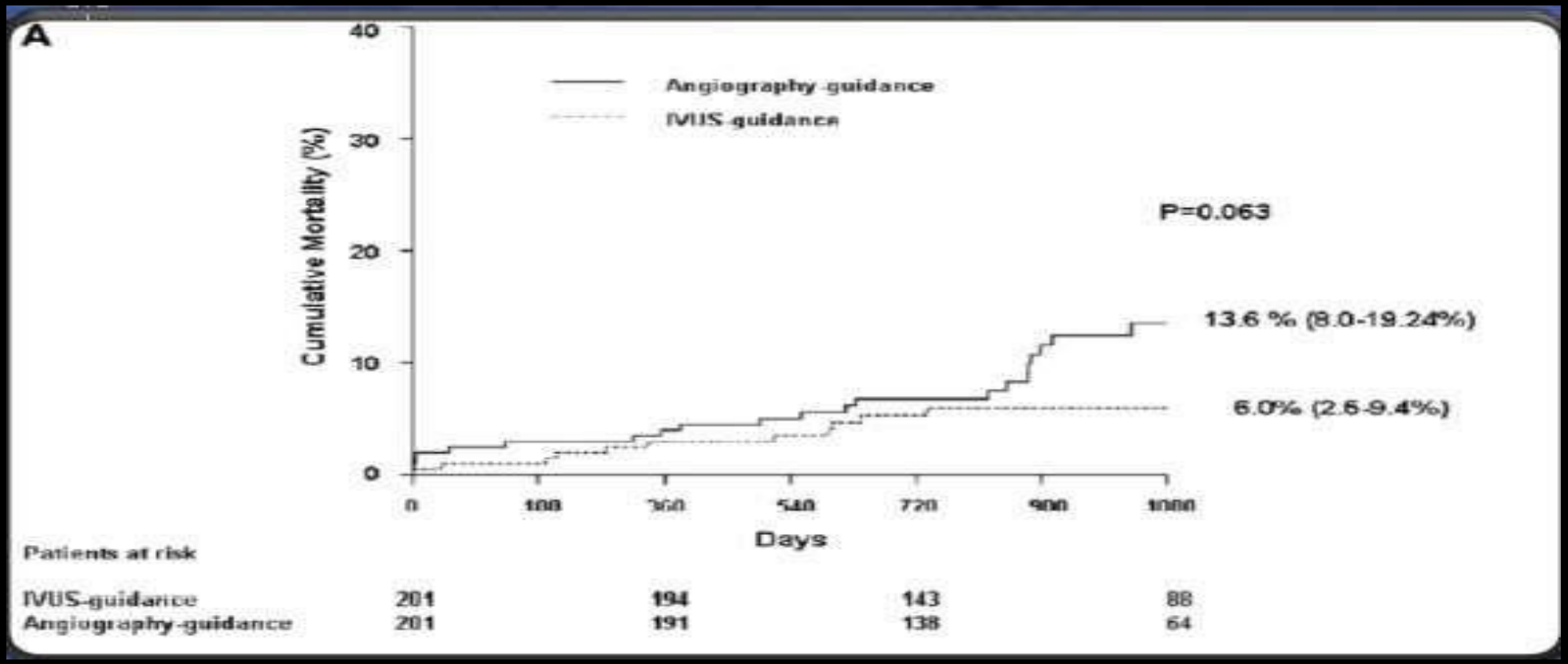
IVUS

- IVUS provides additional information such as minimal and maximal diameters, cross-sectional area and plaque area compared with coronary angiography alone.
- IVUS help to ensure stent optimization of LM PCI.
- IVUS can ensure adequate expansion and apposition of stents after LM PCI, which improves clinical outcomes following LM PCI.

Result of IVUS

- MAIN-COMPARE registry reported that IVUS guidance was associated with improved 3-year mortality compared with a conventional angiography-guided procedure.

- Pts receiving DES, IVUS-guided PCI associated with a significantly lower 3-year incidence of mortality compared with angio-guided PCI



Role of FFR in intermediate LMCA stenosis

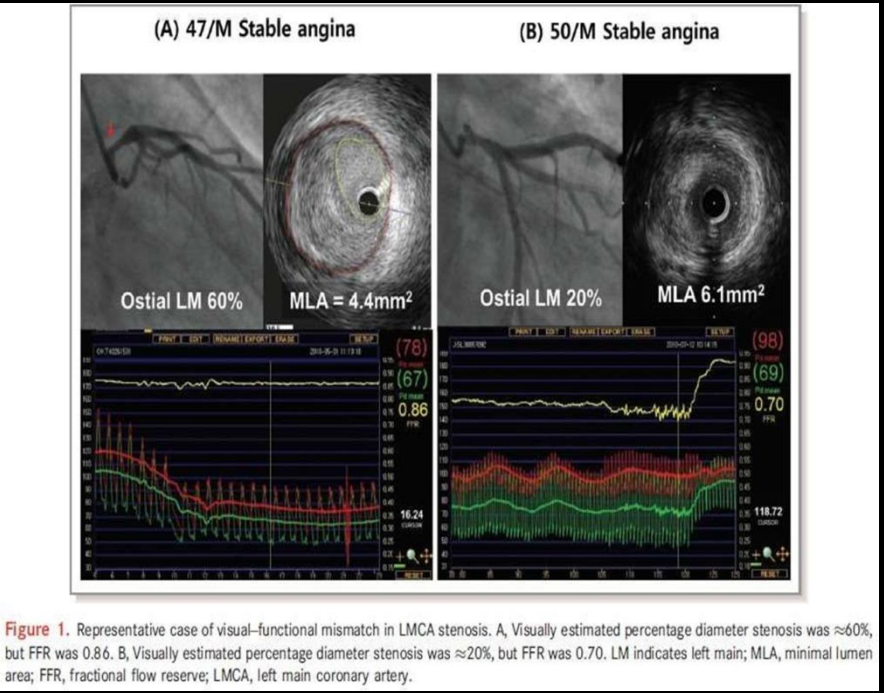


Figure 1. Representative case of visual–functional mismatch in LMCA stenosis. A, Visually estimated percentage diameter stenosis was ≈60%, but FFR was 0.86. B, Visually estimated percentage diameter stenosis was ≈20%, but FFR was 0.70. LM indicates left main; MLA, minimal lumen area; FFR, fractional flow reserve; LMCA, left main coronary artery.

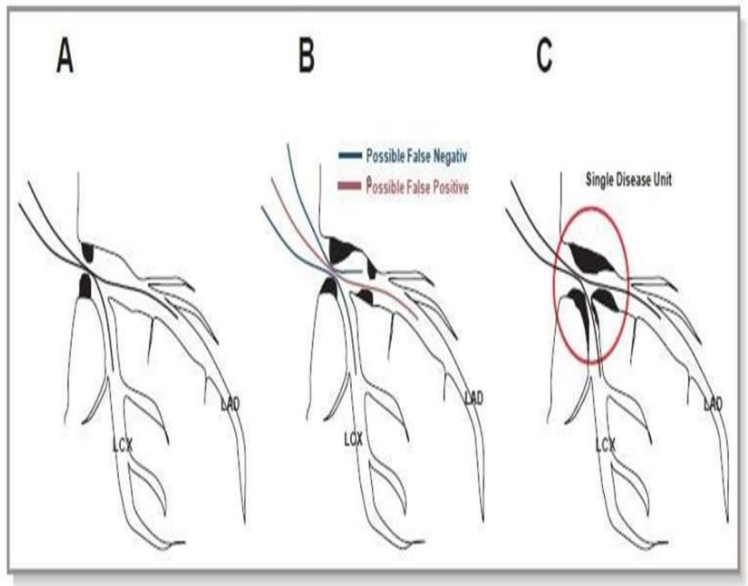


Figure 2. Practical approach for the evaluation of functional significance of left main coronary artery stenosis. LAD indicates left anterior descending artery; LCX, left circumflex artery.

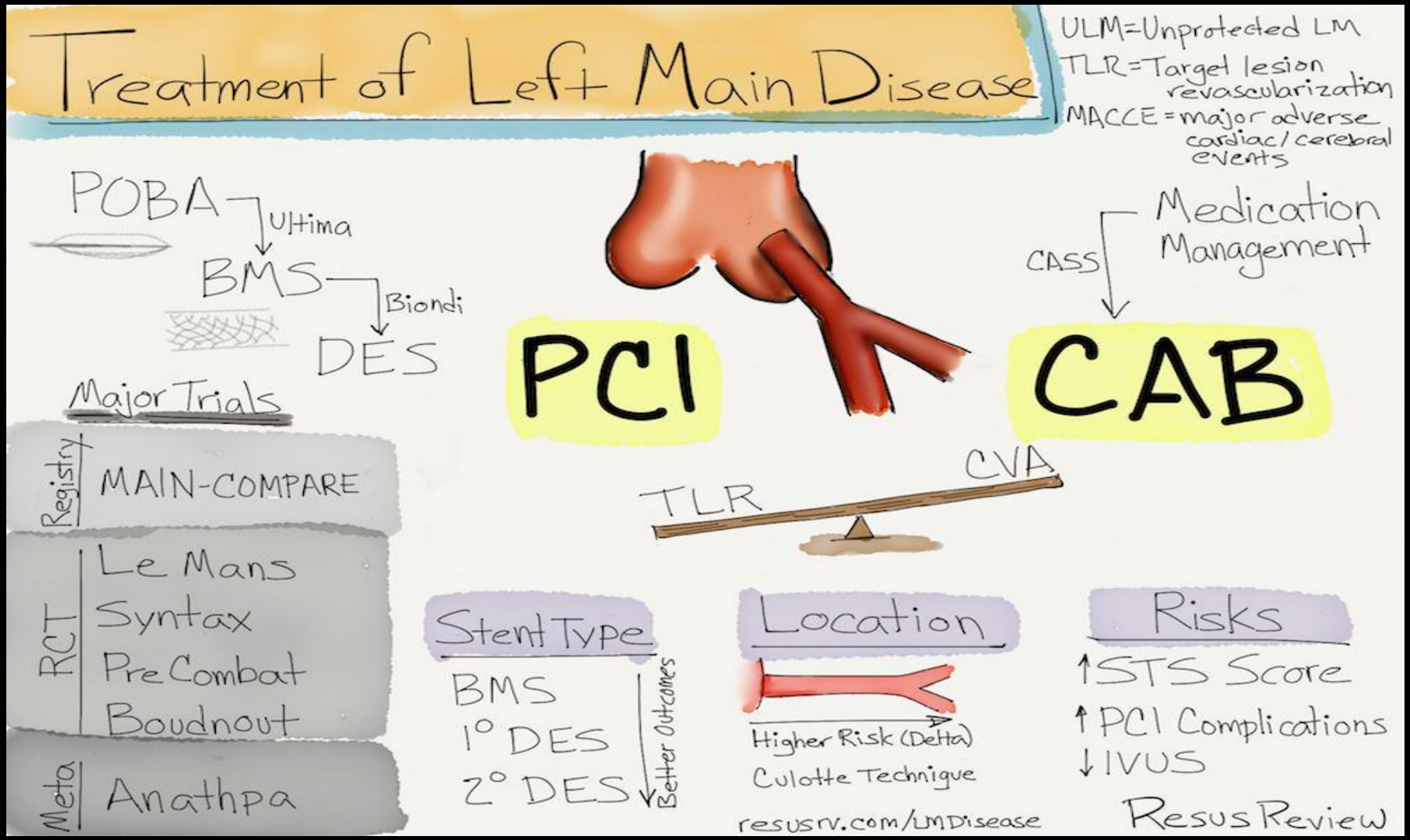
- FFR is a better tool for assessing the hemodynamically significance of an LM stenosis.
- FFR may have a role in deciding whether patients with angiographically mild or moderate LMCA disease should undergo revascularization.

When to treat the left main?

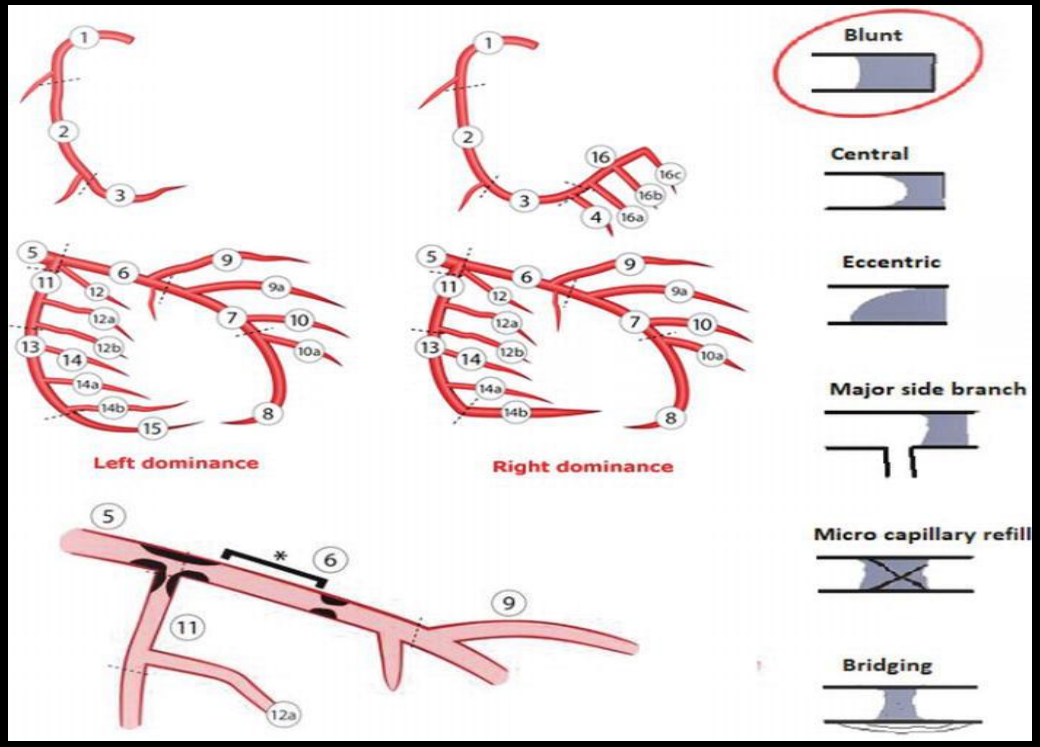
- According to the European guidelines, myocardial revascularization is indicated for patients with LM angiographic stenosis >50% and documentation of myocardial ischaemia.

- However, in clinical practice, evidence of myocardial ischaemia may be uncertain and LM disease is sometimes difficult to assess with coronary angiography.

TREATMENT OF SIGNIFICANT LMCA DISEASE

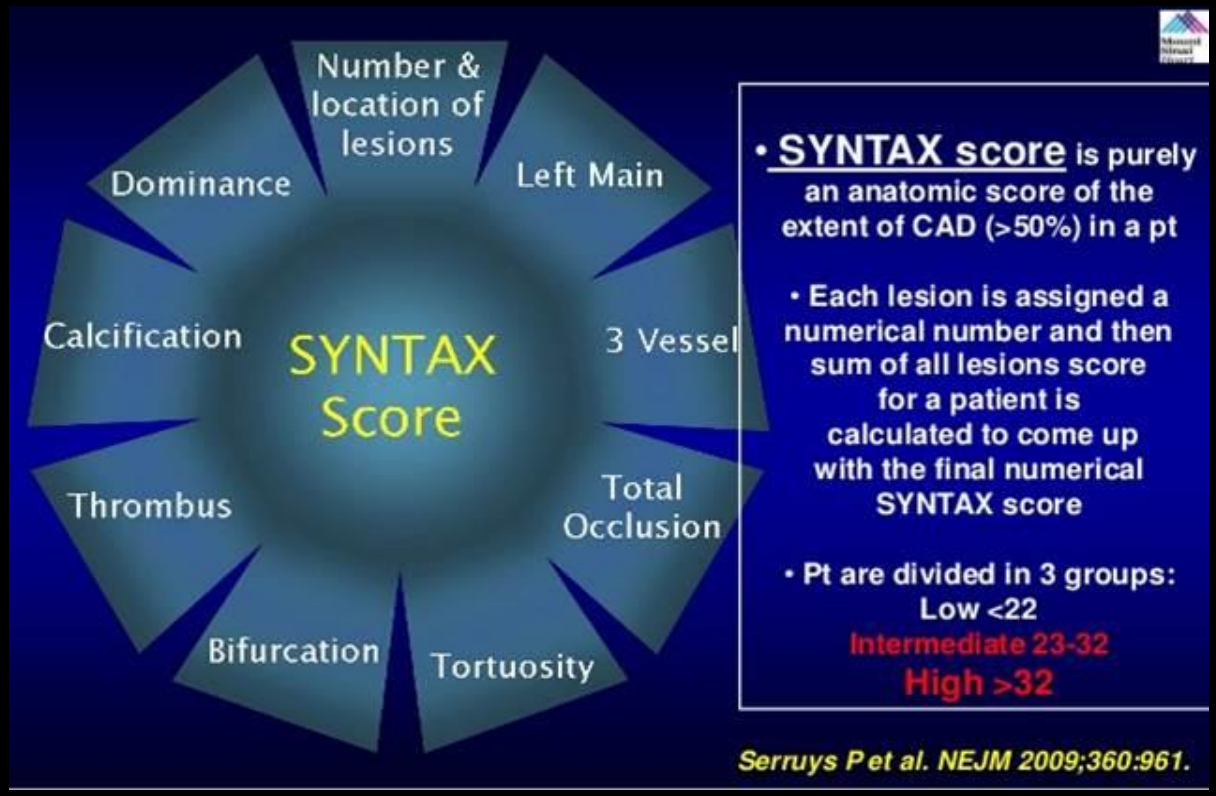


Scoring systems for decision-making in LMCA disease



- Several scoring systems have been developed for risk stratification and decision making of optimum revascularization strategy.
- ACCF/AHA guideline suggests that calculation of the SYNTAX scores is reasonable in patients with unprotected LM and complex CAD (Class IIa recommendation, level of evidence; B).

SYNTAX SCORE



By the highlights of these variables, a separate number is calculated for each lesion. Then, these values are summed up to generate the total SYNTAX score.

Some of the steps illustrating the SYNTAX scoring system; available online at: http://www.syntaxscore.com

PCI vs. CABG

PCI could be considered in

- Elderly patients
- Patients with small left circumflex artery
- Patients with low or intermediate SYNTAX score.
- Non-diabetic patients
- Poor surgical candidates
- Distal coronary disease unfavourable to CABG
- High surgical risk (high EuroSCORE)
- Co-morbidity (chronic obstructive lung disease)
- Emergency clinical situation, i.e. acute LM occlusion

CABG could be considered in

- Patients with heavy calcified LM disease
- Reduced LV function
- Diabetic patients particularly with insulin-dependent diabetes
- MVD suitable for CABG (particularly with low EuroSCORE).
- Distal LM bifurcation lesion with reduced LV function or with occluded RCA or with additional
- Complex lesions on the other coronary vessels (high SYNTAX score)

Favorable vs. Unfavorable LMD for PCI

Favorable

- Ostial LMD
- Mid shaft LMD
- Isolated LMD
- LM diameter≥3.5mm
- Patent RCA
- No/mildly calcified
- Good LV function

Unfavorable

- Distal LM
- Ostial LAD/LCX involvement
- Sharp LAD/LCX angles
- LM diameter<3.5 mm
- Occluded RCA
- Poor LV function
- Associated valve pathology

PCI vs. CABG

PCI advantages

- Less invasive and shorter hospitalization
- Lower risk of periprocedural adverse events
- Long-term durability due to low risk of disease progression

CABG advantages

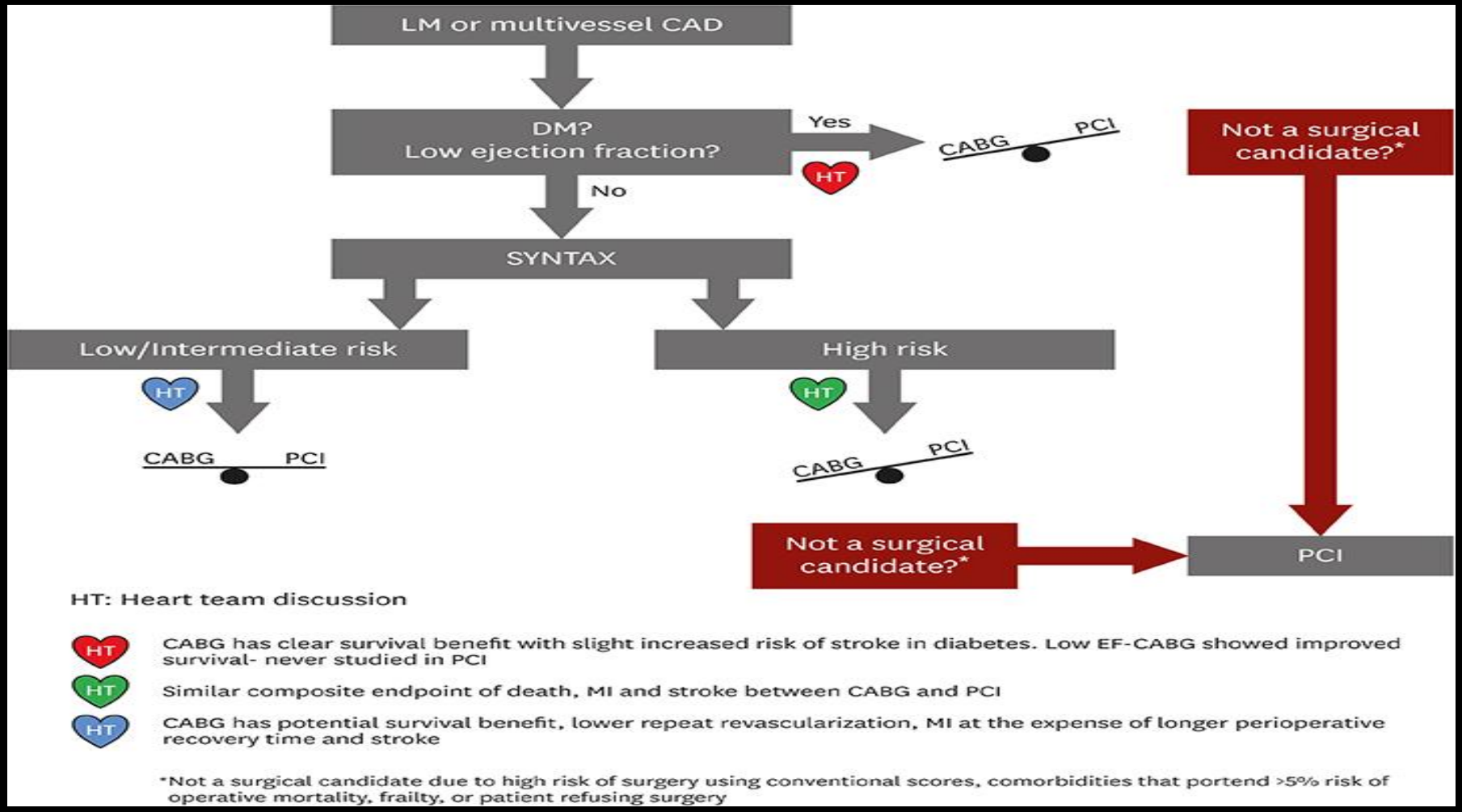
- Lower risk of MACCE and repeat revascularization
- More complete revascularization
- Protection against events related to disease progression

HEART TEAM

- Current guidelines stress the importance of a "heart team" approach to management of complex coronary disease including left main disease.

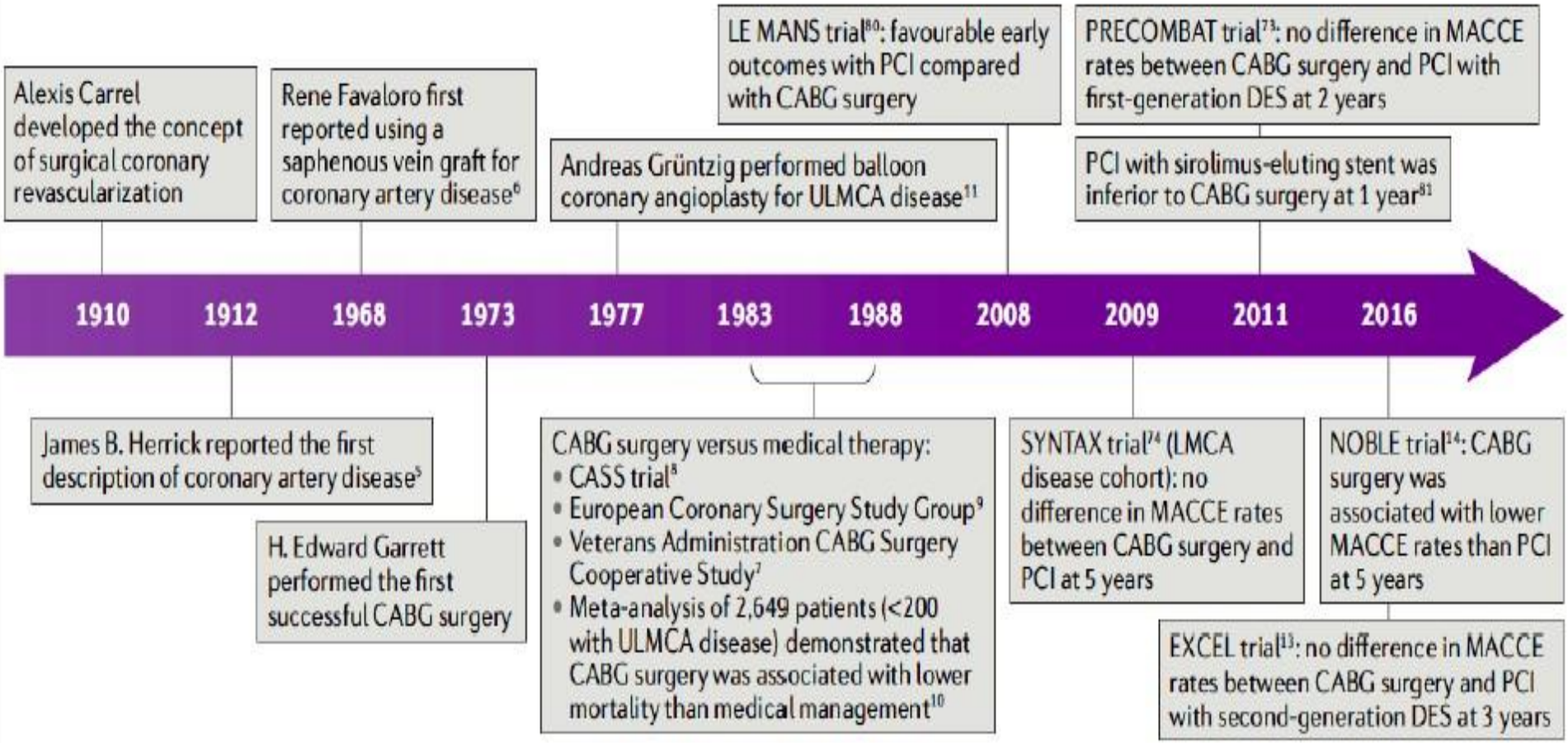
- The "Heart Team," made up of clinical or noninvasive cardiologists, cardiac surgeons and interventional cardiologists, provides a balanced, multidisciplinary decision-making process in consideration the social and cultural context, will often require interaction between these branches.

Algorithm for heart team management of LM coronary artery disease multivessel CAD



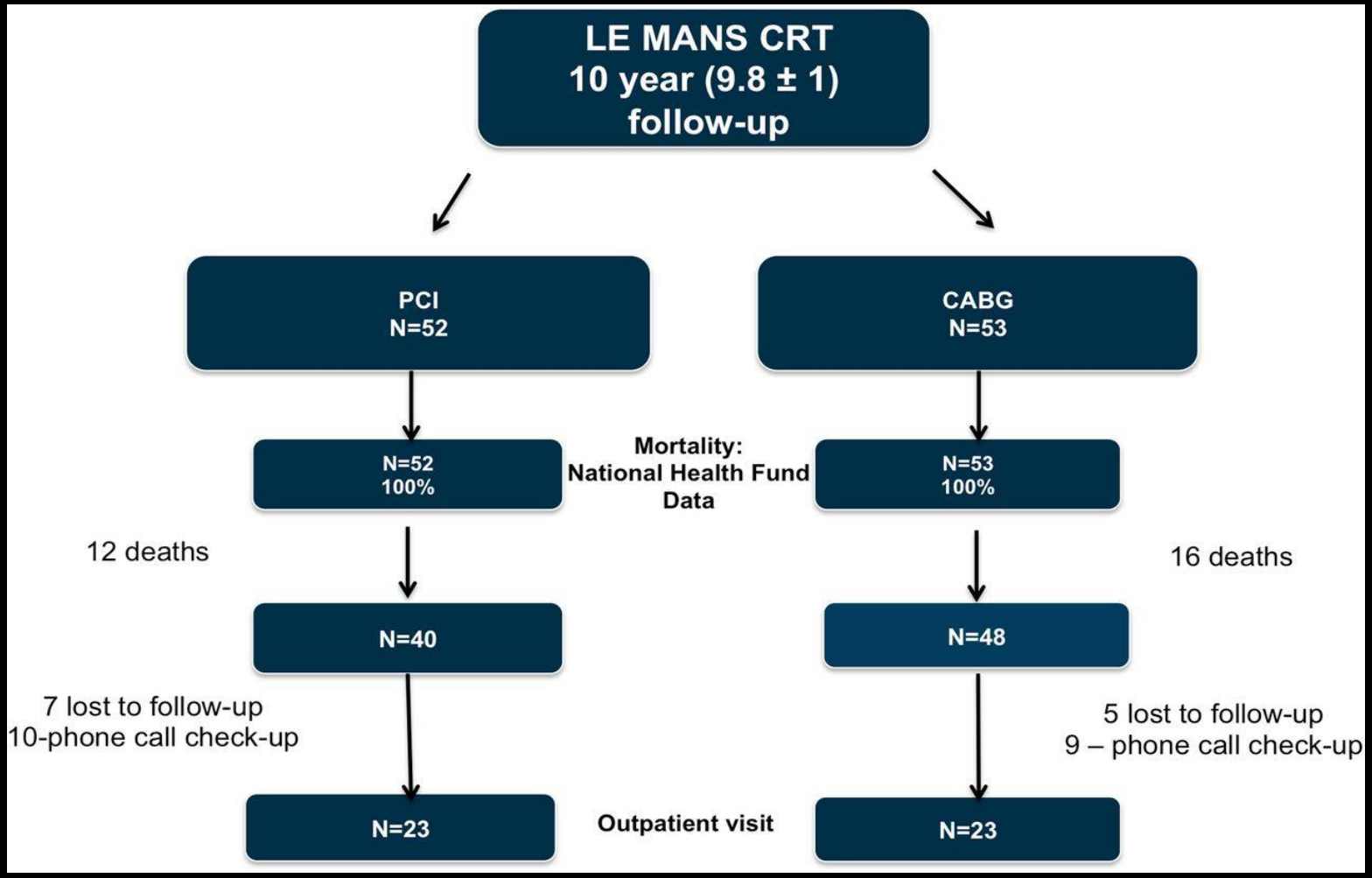
RCTs of LM Revascularization

Historical perspective of the evolution of myocardial revascularization for patients with LM disease



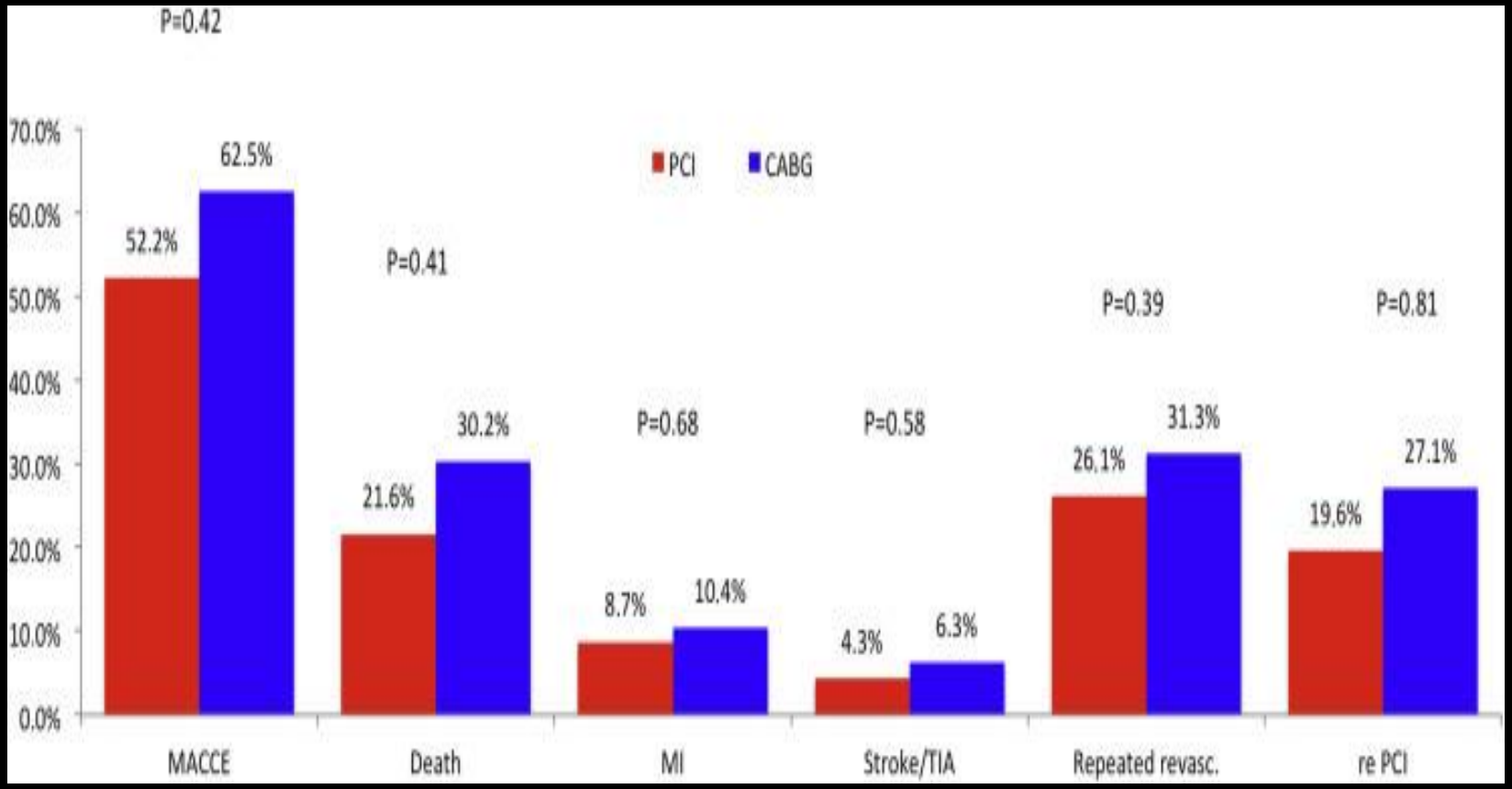
ESC Congress

Collet Cet al. Nat Rev Cardiol 2018; 15:321-331



Pawel E. Buszman et al. JCIN 2016;9:318-327

The first RCT



Major Adverse Cardiovascular Events at 10 Years

MACCE = major adverse cardiovascular and cerebral events; MI = myocardial infarction; TIA = transient ischemic attack

MACCE-free survival was similar in both groups, with a trend toward improved survival after PCI

SYNTAX

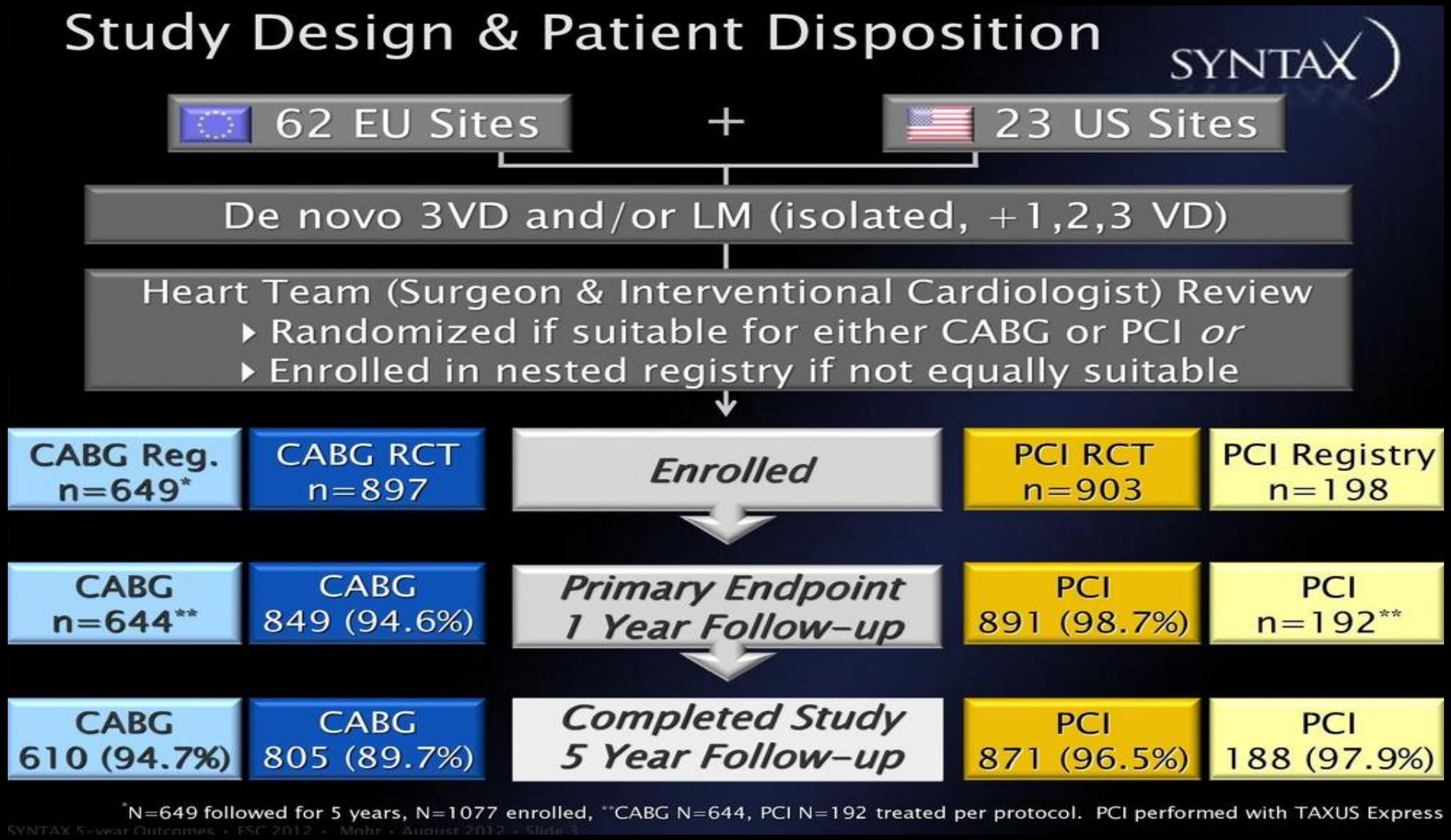
Final Five-Year Follow-up of the SYNTAX Trial:

Optimal Revascularization Strategy in Patients With Three-Vessel Disease and/or Left Main Disease

Patrick W. Serruys, MD, PhD
Thorax Centre, Erasmus MC
On behalf of the SYNTAX investigators

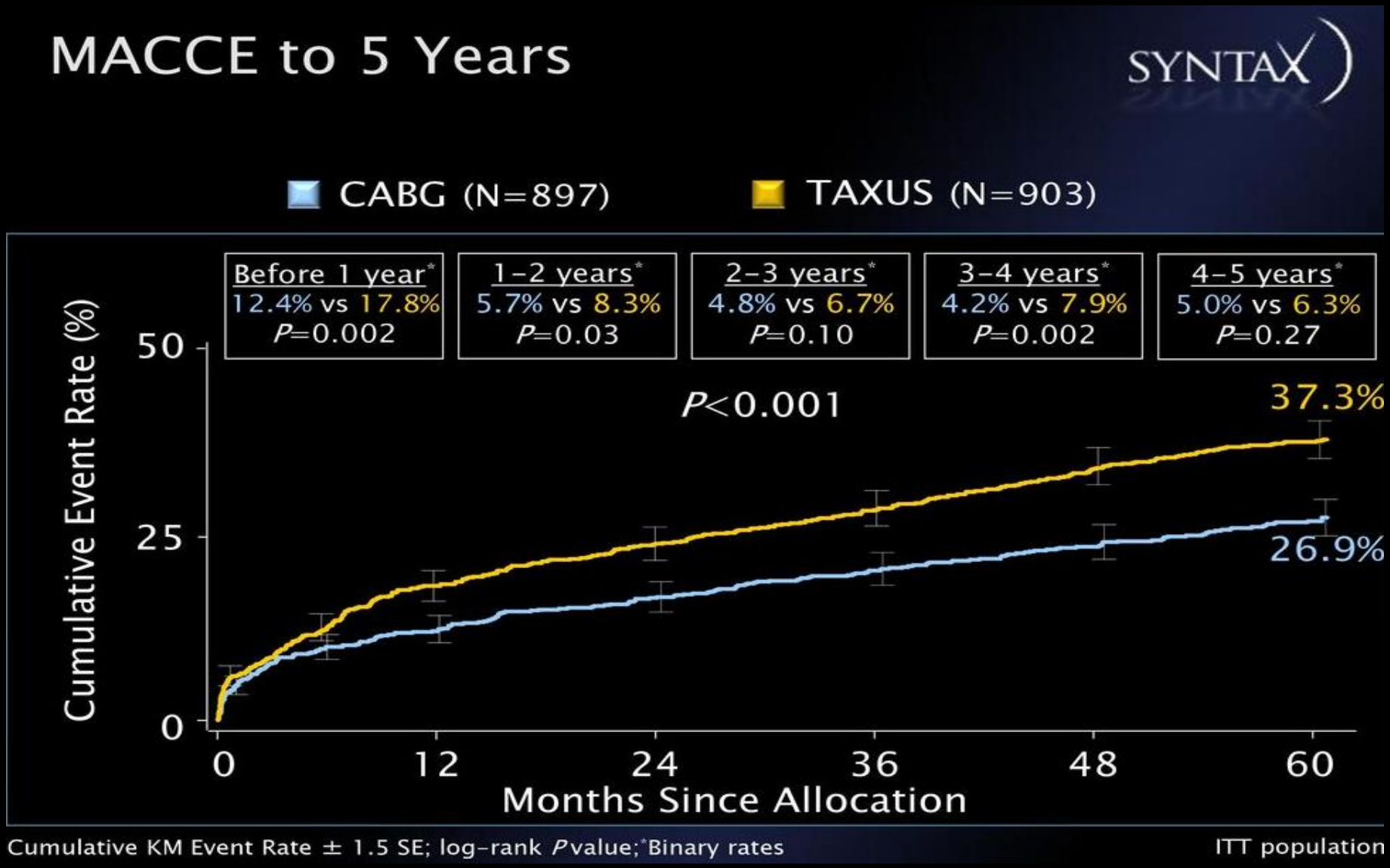
9:06-16 a.m., Oct 22, 2012
Hall A, Coronary theater

SYNTAX trial is the largest RCT to compare PCI to CABG



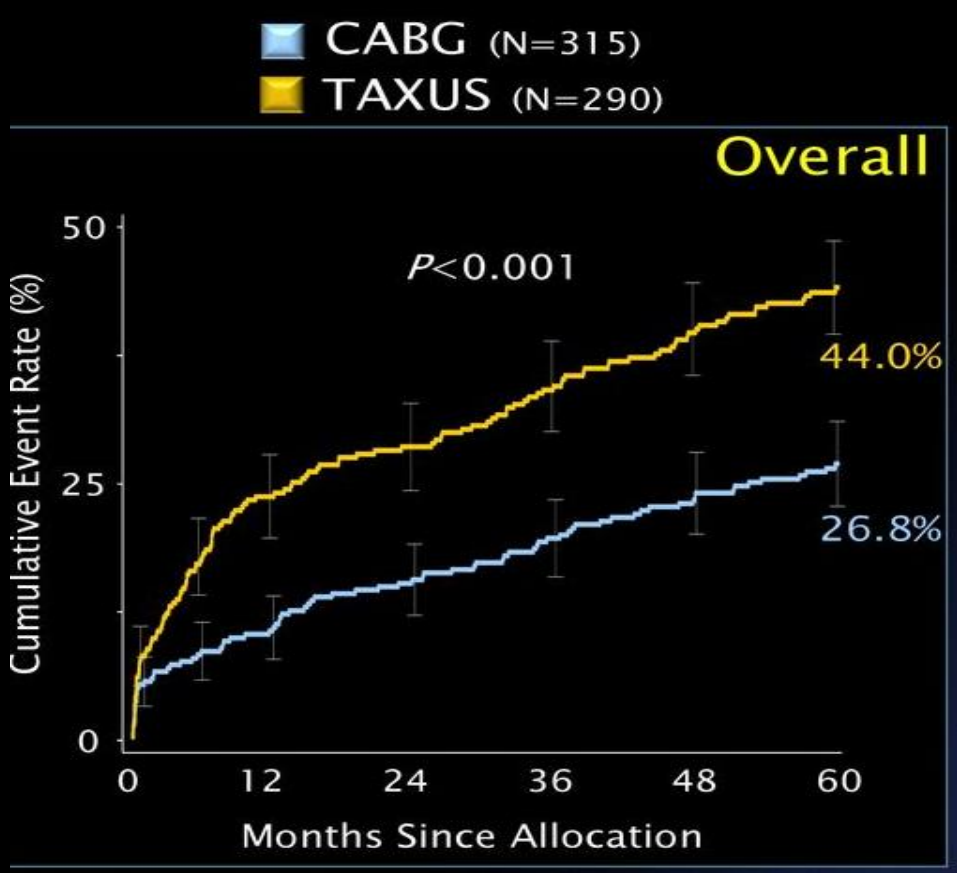
The largest randomized controlled study of PCI versus CABG from 85 centers in the Europe and the United States.

The LMS subset consisted of 705 patients randomised to receiving either the first-generation TAXUS DES or CABG. The primary endpoint of MACE at 1 year and 5-year follow-up.



No significant difference in MACCE between PCI and CABG in the LM CAD subgroup

MACCE to 5 Years by SYNTAX Score Tercile *High Scores (≥33)*



	CABG	PCI	*P* value
Death	11.4%	19.2%	0.005
CVA	3.7%	3.5%	0.80
MI	3.9%	10.1%	0.004
Death, CVA or MI	17.1%	26.1%	0.007
Revasc.	12.1%	30.9%	<0.001

Cumulative KM Event Rate ± 1.5 SE; log-rank *P* value

Core lab-reported Data; ITT populatio

In the LM subgroup with high SYNTAX scores (≥ 33) who underwent PCI had a significantly higher MACCE rate compared to those in the CABG group.
These results suggest that in LM CAD, with low to intermediate SYNTAX scores (≤ 32), PCI is a reasonable alternative to CABG.

BOUDRIOT TRIAL

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ISSN 0735-1097/$36.00
doi:10.1016/j.jacc.2010.09.038

CLINICAL RESEARCH — Interventional Cardiology

Randomized Comparison of Percutaneous Coronary Intervention With Sirolimus-Eluting Stents Versus Coronary Artery Bypass Grafting in Unprotected Left Main Stem Stenosis

Enno Boudriot, MD,* Holger Thiele, MD,* Thomas Walther, MD,† Christoph Liebetrau, MD,* Peter Boeckstegers, MD,‡ Tilmann Pohl, MD,‡ Bruno Reichart, MD,§ Harald Mudra, MD,‖ Florian Beier, MD,‖ Brigitte Gansera, MD,¶ Franz-Josef Neumann, MD,# Michael Gick, MD,# Thomas Zietak, MD,** Steffen Desch, MD,* Gerhard Schuler, MD,* Friedrich-Wilhelm Mohr, MD†

Leipzig, Munich, and Bad Krozingen, Germany

Objectives The purpose of this randomized study was to compare sirolimus-eluting stenting with coronary artery bypass grafting (CABG) for patients with unprotected left main (ULM) coronary artery disease.

Background CABG is considered the standard of care for treatment of ULM. Improvements in percutaneous coronary intervention (PCI) with use of drug-eluting stents might lead to similar results. The effectiveness of drug-eluting stenting versus surgery has not been established in a randomized trial.

Methods In this prospective, multicenter, randomized trial, 201 patients with ULM disease were randomly assigned to undergo sirolimus-eluting stenting ($n = 100$) or CABG using predominantly arterial grafts ($n = 101$). The primary clinical end point was noninferiority in freedom from major adverse cardiac events, such as cardiac death, myocardial infarction, and the need for target vessel revascularization within 12 months.

Results The combined primary end point was reached in 13.9% of patients after surgery, as opposed to 19.0% after PCI ($p = 0.19$ for noninferiority). The combined rates for death and myocardial infarction were comparable (surgery, 7.9% vs. stenting, 5.0%; noninferiority $p < 0.001$), but stenting was inferior to surgery for repeat revascularization (5.9% vs. 14.0%; noninferiority $p = 0.35$). Perioperative complications including 2 strokes were higher after surgery (4% vs. 30%; $p < 0.001$). Freedom from angina was similar between groups ($p = 0.33$).

BOUDRIOT TRIAL CONCLUSIONS

In patients with ULM stenosis, PCI with sirolimus-eluting stents did not show non-inferiority to CABG at 12-month follow-up with respect to freedom from major adverse cardiac events, which is mainly influenced by repeated revascularization, whereas for hard endpoints, PCI results are favorable.

J Am Coll Cardiol. 2015 May 26;65(20):2198-206. doi: 10.1016/j.jacc.2015.03.033. Epub 2015 Mar 15.

Randomized Trial of Stents Versus Bypass Surgery for Left Main Coronary Artery Disease: 5-Year Outcomes of the PRECOMBAT Study.

BACKGROUND: In a previous randomized trial, we found that percutaneous coronary intervention (PCI) was not inferior to coronary artery bypass grafting (CABG) for the treatment of unprotected left main coronary artery stenosis at 1 year.

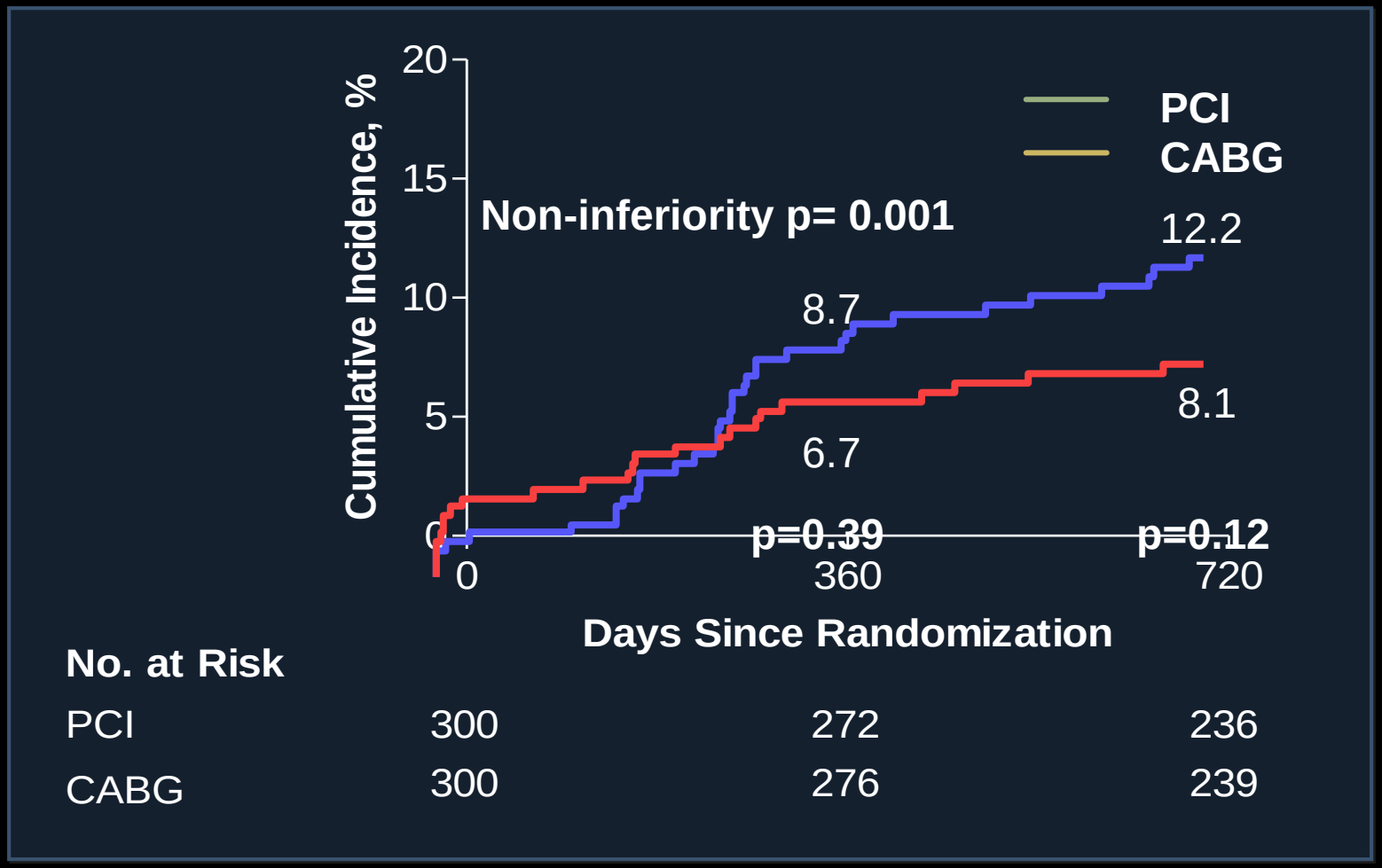
OBJECTIVES: This study sought to determine the 5-year outcomes of PCI compared with CABG for the treatment of unprotected left main coronary artery stenosis.

METHODS: We randomly assigned 600 patients with unprotected left main coronary artery stenosis to undergo PCI with a sirolimus-eluting stent (n = 300) or CABG (n = 300). The primary endpoint was a major adverse cardiac or cerebrovascular event (MACCE: a composite of death from any cause, myocardial infarction, stroke, or ischemia-driven target vessel revascularization) and compared on an intention-to-treat basis.

RESULTS: At 5 years, MACCE occurred in 52 patients in the PCI group and 42 patients in the CABG group (cumulative event rates of 17.5% and 14.3%, respectively; hazard ratio [HR]: 1.27; 95% confidence interval [CI]: 0.84 to 1.90; p = 0.26). The 2 groups did not differ significantly in terms of death from any cause, myocardial infarction, or stroke as well as their composite (8.4% and 9.6%; HR, 0.89; 95% CI, 0.52 to 1.52; p = 0.66). Ischemia-driven target vessel revascularization occurred more frequently in the PCI group than in the CABG group (11.4% and 5.5%, respectively; HR: 2.11; 95% CI: 1.16 to 3.84; p = 0.012).

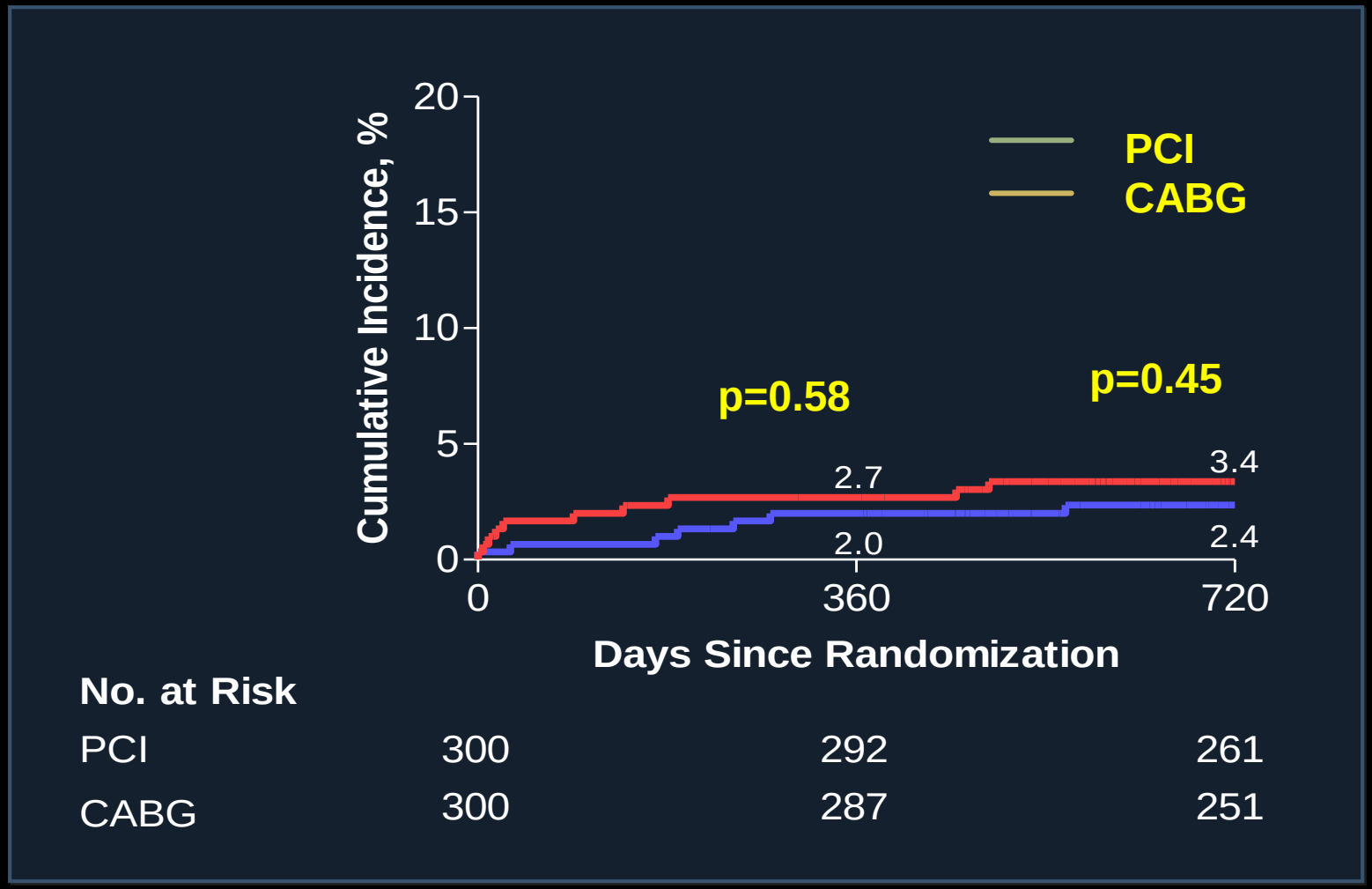
CONCLUSIONS: During 5 years of follow-up, our study did not show significant difference regarding the rate of MACCE between patients who underwent PCI with a sirolimus-eluting stent and those who underwent CABG. However, considering the limited power of our study, our results should be interpreted with caution. (Bypass Surgery Versus Angioplasty Using Sirolimus-Eluting Stent in Patients With Left Main Coronary Artery Disease [PRECOMBAT]; NCT00422968).

Primary End Point of MACCE



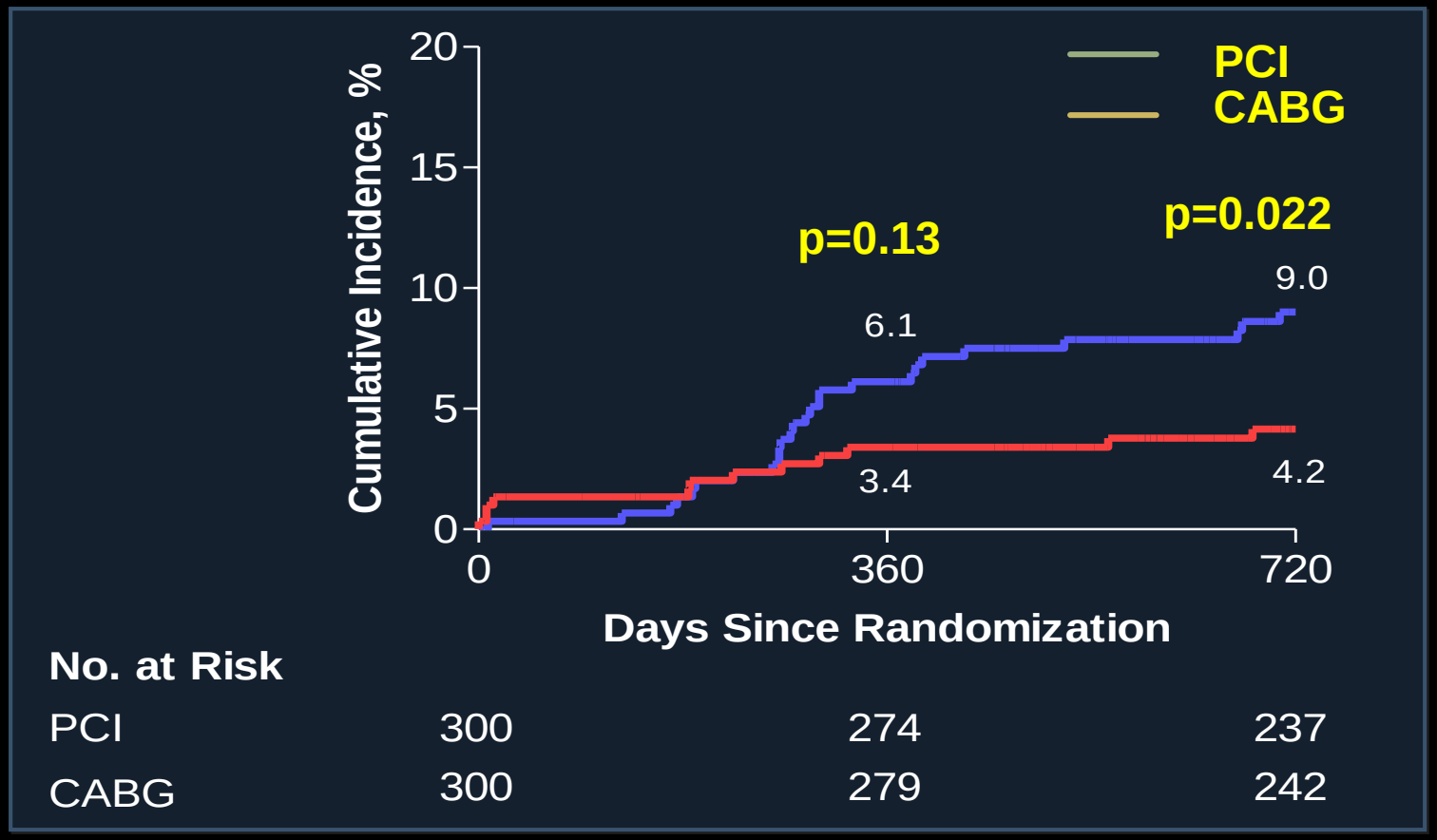
At 2-year follow-up, there was no difference between the two groups in the primary endpoint of MACCE

Death



Or in all-cause mortality

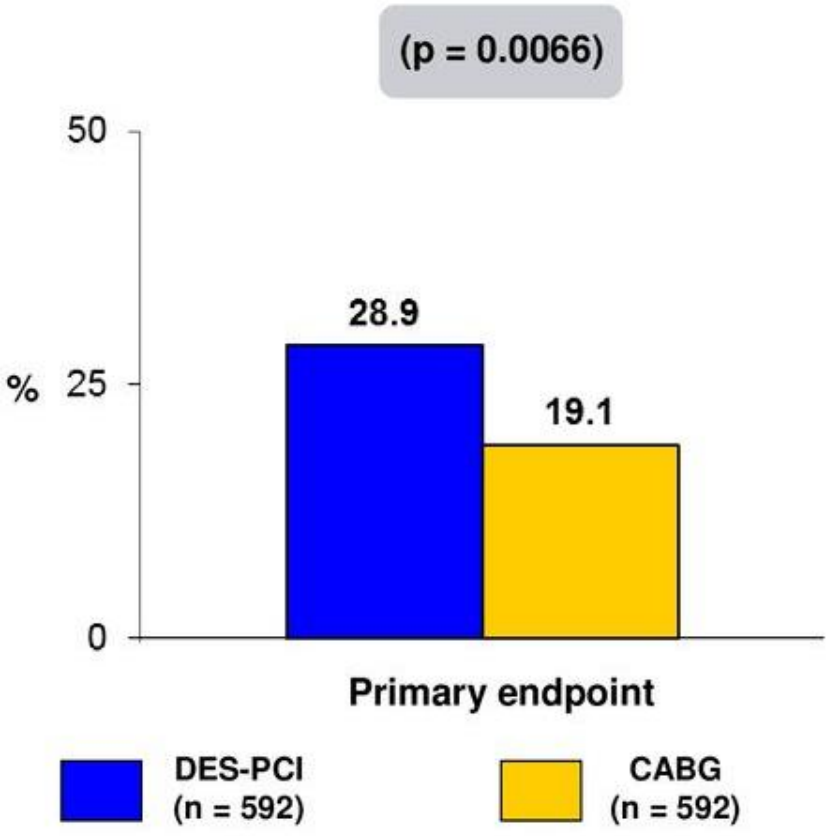
Ischemia-Driven TVR



Ischemia-driven target vessel revascularization was higher in the PCI group compared to those undergoing CABG

NOBEL TRIAL

A prospective, randomized trial 1184 patients were included in the analysis (592 patients in each group). Patients were followed for at least 1 year and extended follow-up was available for a median of 3.1 years.



Results

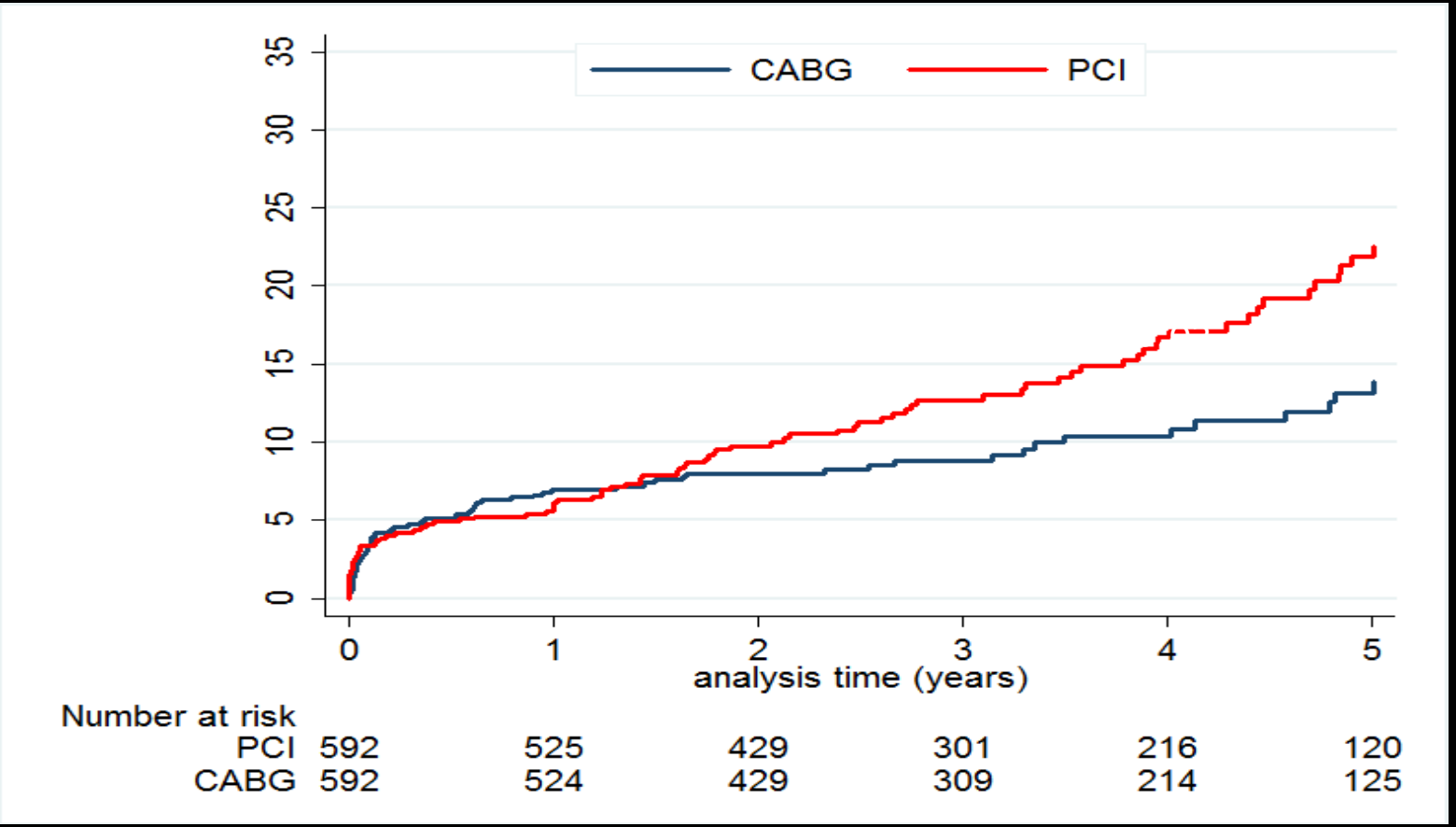
- Primary endpoint: Death/MI/stroke/repeat revasc: PCI vs. CABG: 28.9% vs. 19.1%, p = 0.0066
- Death: 11.6% vs. 9.5%, p = 0.77; MI: 6.9% vs. 1.9%, p = 0.004; stroke: 4.9% vs. 1.7%, p = 0.07; repeat revasc: 16.2% vs. 10.4%, p = 0.03; de novo lesion revasc: 6% vs. 3%, p = 0.018
- Stent thrombosis/graft occlusion: 3% vs. 4%, p = 0.22

Conclusions

- DES-PCI was inferior to CABG for clinical outcomes at 5 years following revascularization of unprotected left main lesions
- The hazard was highest with CABG in the first 30 days with better outcomes with PCI; between 30 days and 5 years, outcomes were inferior with PCI compared with CABG

Mäkikallio T, et al. Lancet 2016;388:2743-52

MACCE: Death, MI, stroke



Kaplan–Meier estimates of MACCE were significantly higher in PCI (28%) compared to CABG (18%).

Outcomes 30 days of follow-up

	PCI (n=592)	CABG (n=592)	Risk difference (95% CI)	p value
All-cause mortality	2 (<1%)	7 (1%)	–0·8% (–1·8 to 0·1)	0·09
Cardiac death	2 (<1%)	7 (1%)	–0·8% (–1·8 to 0·1)	0·09
Vascular death	0	0	0%	1·00
Procedural myocardial infarction*	16/296 (5%)	16/238 (7%)	–1·3% (–5·4 to 2·8)	0·52
Non-procedure-related myocardial infarction	3 (1%)	0	0·5% (–0·06 to 1·1)	0·08
Definite stent thrombosis or symptomatic graft occlusion	1 (<1%)	2 (<1%)	–0·1% (–0·7 to 0·4)	0·56
Repeat revascularisation	7 (1%)	10 (2%)	–0·5% (–1·8 to 0·8)	0·46
Stroke	0	4 (<1%)	–0·7% (–1·3 to –0·01)	0·04
Reoperation for bleeding	1 (<1%)	23 (4%)	–3·7% (–5·3 to –2·1)	<0·0001
Blood transfusion	11 (2%)	150 (28%)	–25·4% (–29·3 to –21·5)	<0·0001
Surgery for sternum infection	0	3 (<1%)	–0·5% (–1·1 to 0·07)	0·08
Surgery for access site complications	2 (<1%)	4 (1%)	0·3% (–1·2 to 0·5)	0·41
CT-verified pulmonary embolus	1 (<1%)	1 (<1%)	0·0% (–0·4 to 0·9)	0·99
Duration of index treatment admission (days)	2 (1–4)	9 (7–13)	..	<0·0001

The stroke rate in PCI group was significantly less than in the CABG group. Disadvantages of CABG during the first 30 days due higher blood transfusion rate, reoperation for bleeding and reoperation for sternum infection.

EXCEL

ORIGINAL ARTICLE

Five-Year Outcomes after PCI or CABG for Left Main Coronary Disease

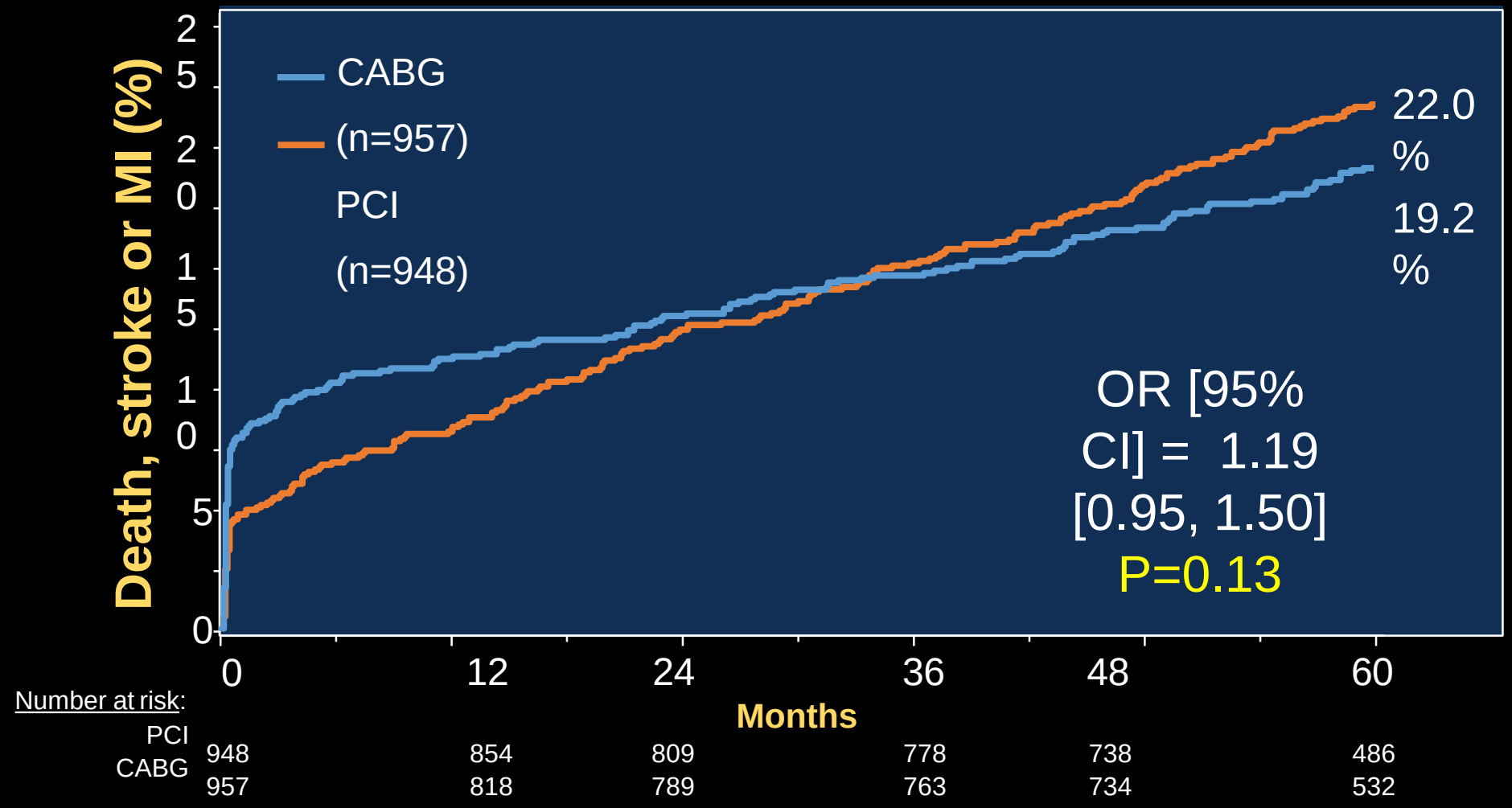
G.W. Stone, A.P. Kappetein, J.F. Sabik, S.J. Pocock, M.-C. Morice, J. Puskas, D.E. Kandzari, D. Karmpaliotis, W.M. Brown III, N.J. Lembo, A. Banning, B. Merkely, F. Horkay, P.W. Boonstra, A.J. van Boven, I. Ungi, G. Bogáts, S. Mansour, N. Noiseux, M. Sabaté, J. Pomar, M. Hickey, A. Gershlick, P.E. Buszman, A. Bochenek, E. Schampaert, P. Pagé, R. Modolo, J. Gregson, C.A. Simonton, R. Mehran, I. Kosmidou, P. Généreux, A. Crowley, O. Dressler, and P.W. Serruys, for the EXCEL Trial Investigators*

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

EXCEL trial was a prospective randomized , non-inferiority trial undertaken at 126 centers in 17 countries around the world.
Patients were randomized to receive either CABG or PCI in patients found to have significant LM CAD and a SYNTAX score of ≤ 32

Primary Endpoint

All-cause Death, Stroke or MI at 5 Years



There was no difference between the two groups in the primary endpoint

Primary Endpoint at 5 Years

	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]

- Death from any cause occurred more frequently in the PCI group than in the CABG group
- The incidences of definite cardiovascular death 5.0% in the PCI groups and 4.5% in the CABG groups (respectively; difference, 0.5 percentage points; 95% CI, −1.4 to 2.5)

Primary Endpoint at 5 Years

	PCI (N=948)	CABG (N=957)	Difference [95% CI]	Odds ratio [95% CI]
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]

- All cerebrovascular events were less frequent after PCI than after CABG (3.3% vs. 5.2%; difference)
- Although the incidence of stroke was not significantly different between the two groups.

Primary Endpoint at 5 Years

	PCI (N=948)	CABG (N=957)	Difference [95% CI]	Odds ratio [95% CI]
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]
Death, stroke, MI or IDR	31.3% (290)	24.9% (228)	6.5% [2.4%, 10.6%]	1.39 [1.13, 1.71]
- ID-revascularization	16.9% (150)	10.0% (88)	6.9% [3.7%, 10.0%]	1.84 [1.39, 2.44]
- PCI	14.1% (125)	9.1% (80)	4.9% [1.9%, 7.9%]	1.65 [1.22, 2.22]
- CABG	4.3% (38)	0.9% (8)	3.4% [1.9%, 4.9%]	4.90 [2.27, 10.56]
All revascularization	17.2% (153)	10.5% (92)	6.7% [3.5%, 9.9%]	1.79 [1.36, 2.36]

- Myocardial infarction were not significantly different (10.6% and 9.1%; difference, 1.4 percentage points; 95% CI, –1.3 to 4.2)
- Ischemia-driven revascularization was more frequent after PCI than after CABG (16.9% vs. 10.0%; difference).

ESC European Society of Cardiology
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2018 ESC/EACTS Guidelines on myocardial revascularization

The Task Force on myocardial revascularization of the European Society of Cardiology (ESC) and European Association for Cardio-Thoracic Surgery (EACTS)

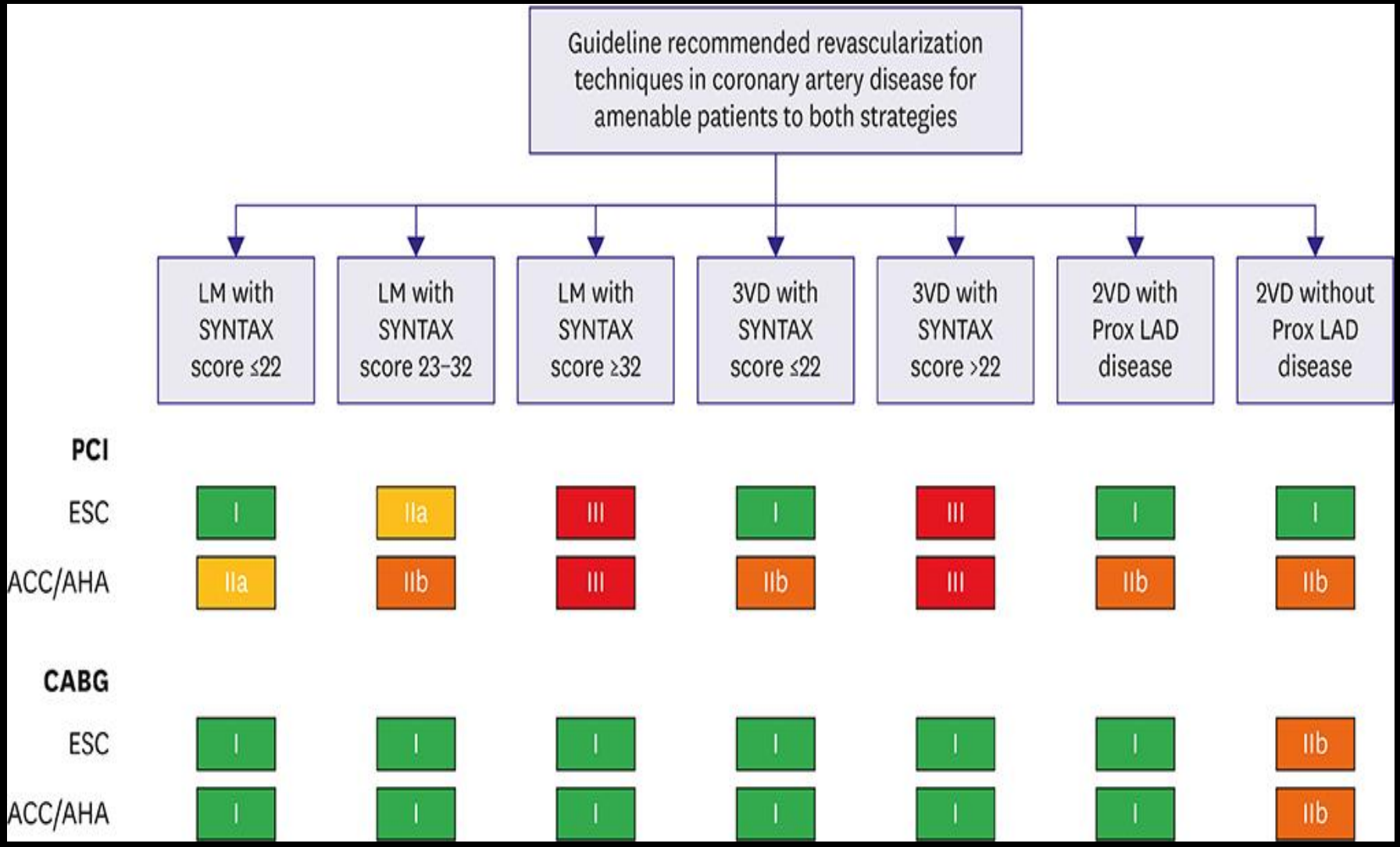
Developed with the special contribution of the European Association for Percutaneous Cardiovascular Interventions (EAPCI)

The Guidelines

Recommendations according to extent of CAD	CABG		PCI	
	Class[a]	Level[b]	Class[a]	Level[b]
Left main CAD				
Left main disease with low SYNTAX score (0 - 22).[69,121,122,124,145–148]	I	A	I	A
Left main disease with intermediate SYNTAX score (23 - 32).[69,121,122,124,145–148]	I	A	IIa	A
Left main disease with high SYNTAX score (≥33).[c 69,121,122,124,146–148]	I	A	III	B
IVUS should be considered to optimize treatment of unprotected left main lesions.[35]	IIa	B		

Neumann et al, EHJ 2018

ACC/AHA and ESC guidelines recommendations on LMD and MVD revascularizations.



CONCLUSIONS

1. LMCA disease is still one of the most challenging areas of disease. Stenting of ULMCA stenosis can be performed with good results in carefully selected patients.
2. CABG surgery has been accepted as the standard revascularization method for patients with high-risk anatomy or multivessel coronary disease with left main stenosis (SYNTAX score > 32).
3. Patients with low or intermediate risk anatomy (SYNTAX score ≤32) either PCI or CABG are reasonable.

CONCLUSIONS (TT)

4. PCI being associated with less morbidity, shorter hospital stays and lower stroke rates in the peri-procedural period than CABG, but also resulting in high rates of repeat revascularization over time despite use of latest generation DES, procedural techniques and medical therapy.
5. Patient selection is important and must be based on medical–surgical consultation (Heart Team concept) and ethics of information.
6. IVUS guidance should be considered and may improve clinical outcomes.


THANK YOU