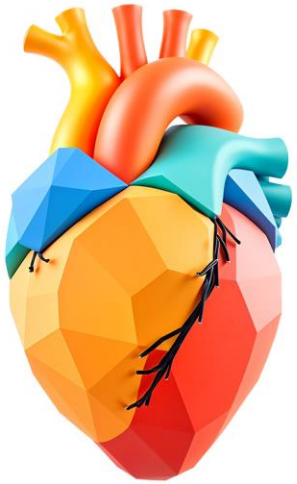

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12th Annual Tehran Heart Center Congress

7th CRITICAL CARDIOVASCULAR CARE

دوازدهمین کنگره سالیانه مرکز قلب تهران

2025

۲۵ و ۲۶ بهمن ماه ۱۴۰۳

13 & 14 February

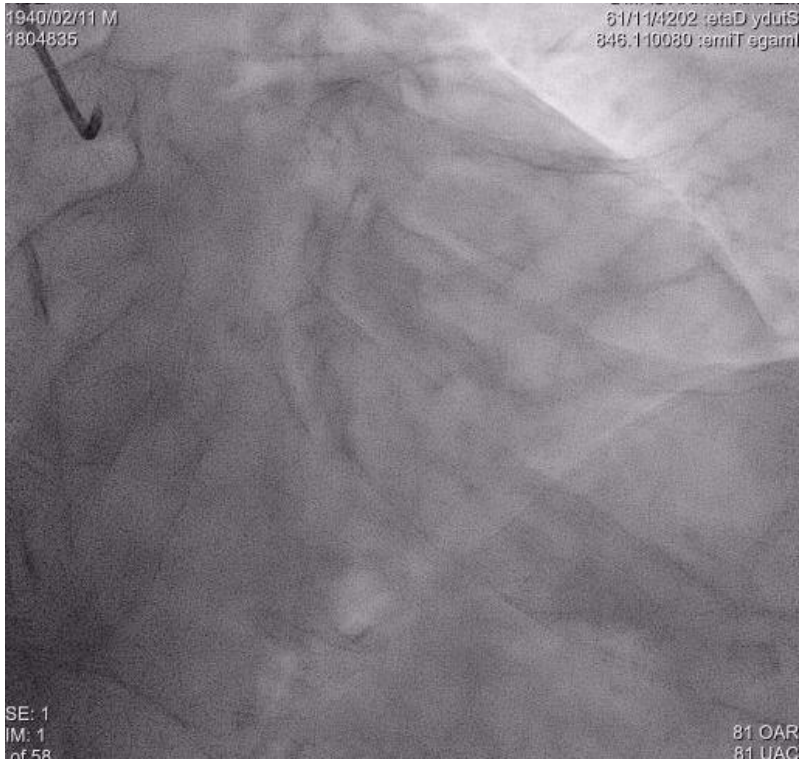
Tehran Heart Center

Tehran, Iran

Evidence-based Management of Left Main Coronary Artery Disease

Mehdi Mehrani. MD

Interventional Cardiologist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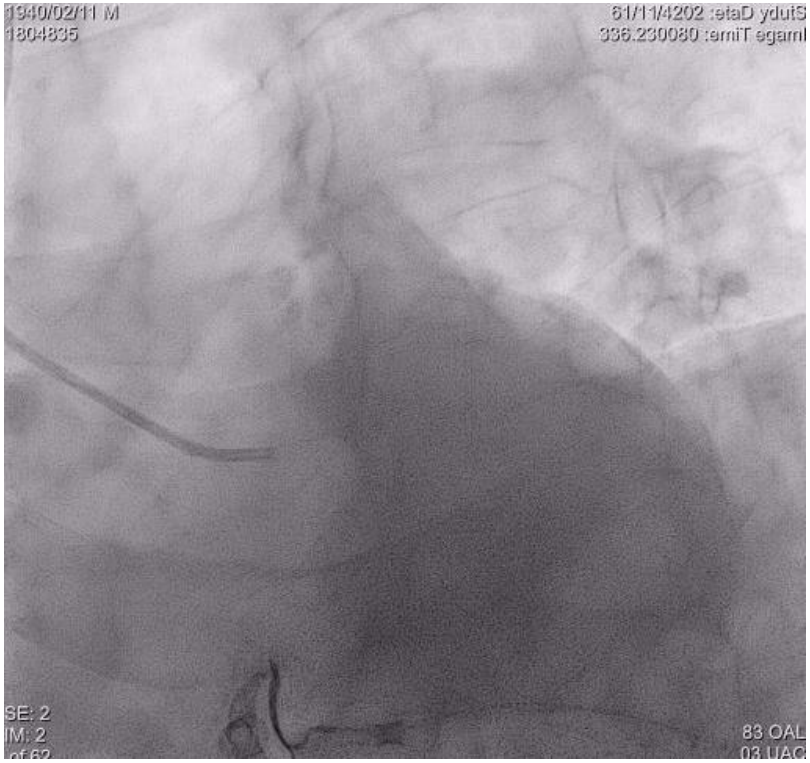
846.110080 :emiT egamI
SE: 1
IM: 1
81 OAR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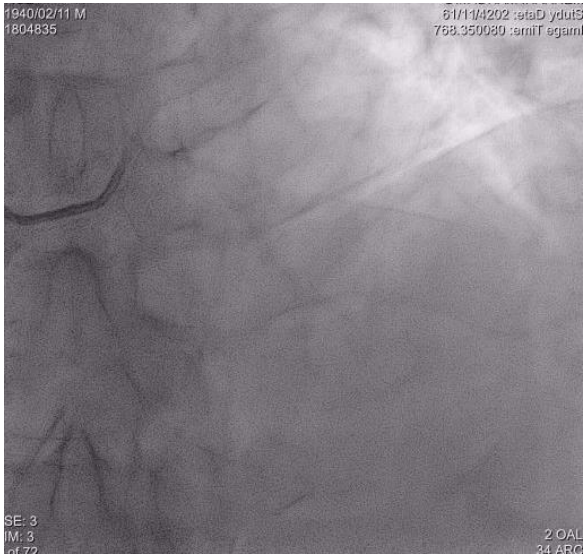
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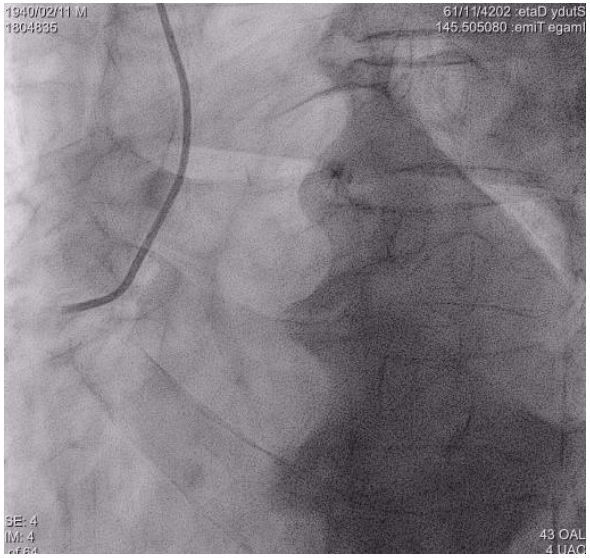
IM: 3
2 OAL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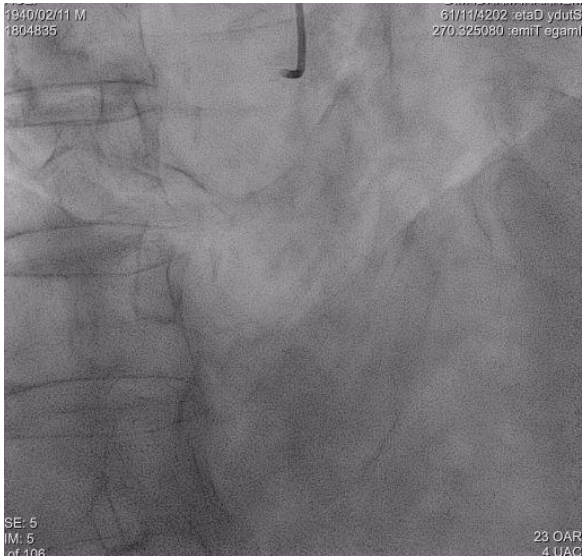
SE: 4
IM: 4
43 OAL
4 UAC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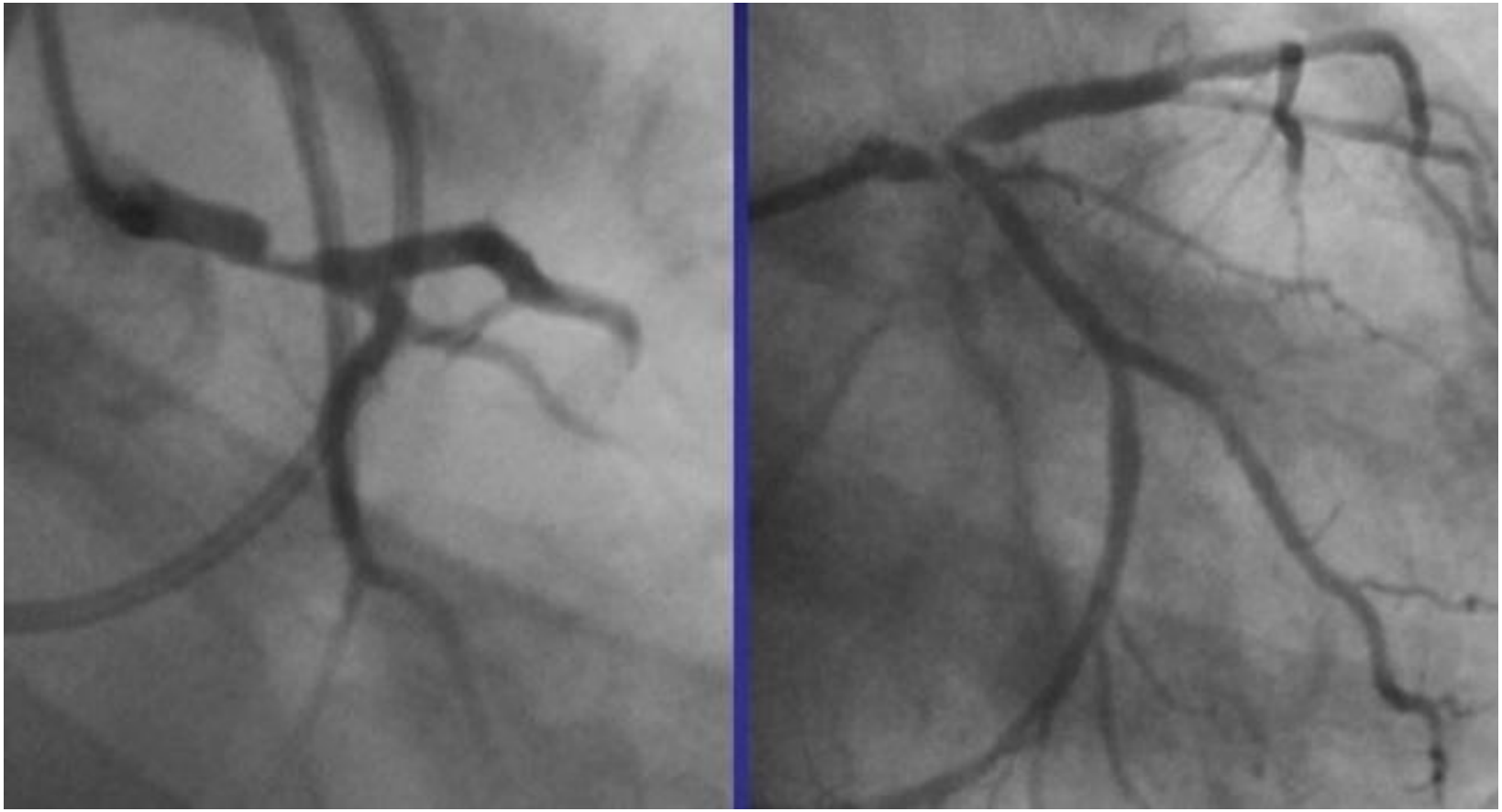
1804835
61/11/4202 :etaD ydutS
270.325080 :emiT egamI
SE: 5
IM: 5
23 OAR
4 UAC



left main coronary artery (LMCA) cohorts represent a minority ~9% of the overall CAD population, they comprise a disproportionally higher component of its associated morbidity and mortality

At the same time, the SWEDEHEART analysis found the left main to be affected in only 5% of the cases but showed that the presence of left main affection is associated with additional multivessel disease in almost 2/3 of those patients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Coronary angiographic findings and outcomes in patients with sudden cardiac arrest without ST-elevation myocardial infarction: A SWEDEHEART study

Anatomy

- Ostial/shaft vs bifurcation
- Simple vs complex
- 50-70% DS vs 70-95% DS
- Intravascular ultrasound diameter

Physiology

- Ischaemic symptoms
- Ischaemic stress test
- Ischaemic FFR/iFR

Natural History

- Risk scores
- Life expectancy
- Progression of disease
- Success of medical therapy

Interventionalist/Surgeon

- Volume
- Expertise
- Experience

Heart Team

- Interventional cardiologist
- Clinical cardiologist
- Cardiac surgeon
- Allied health professional

Hospital

- Health care system and resources
- On-site vs off-site CABG
- PCI/CABG volume and outcomes
- Functional heart team
- Rehab program

Provider-Patient-Institutional Axis

PCI/CABG

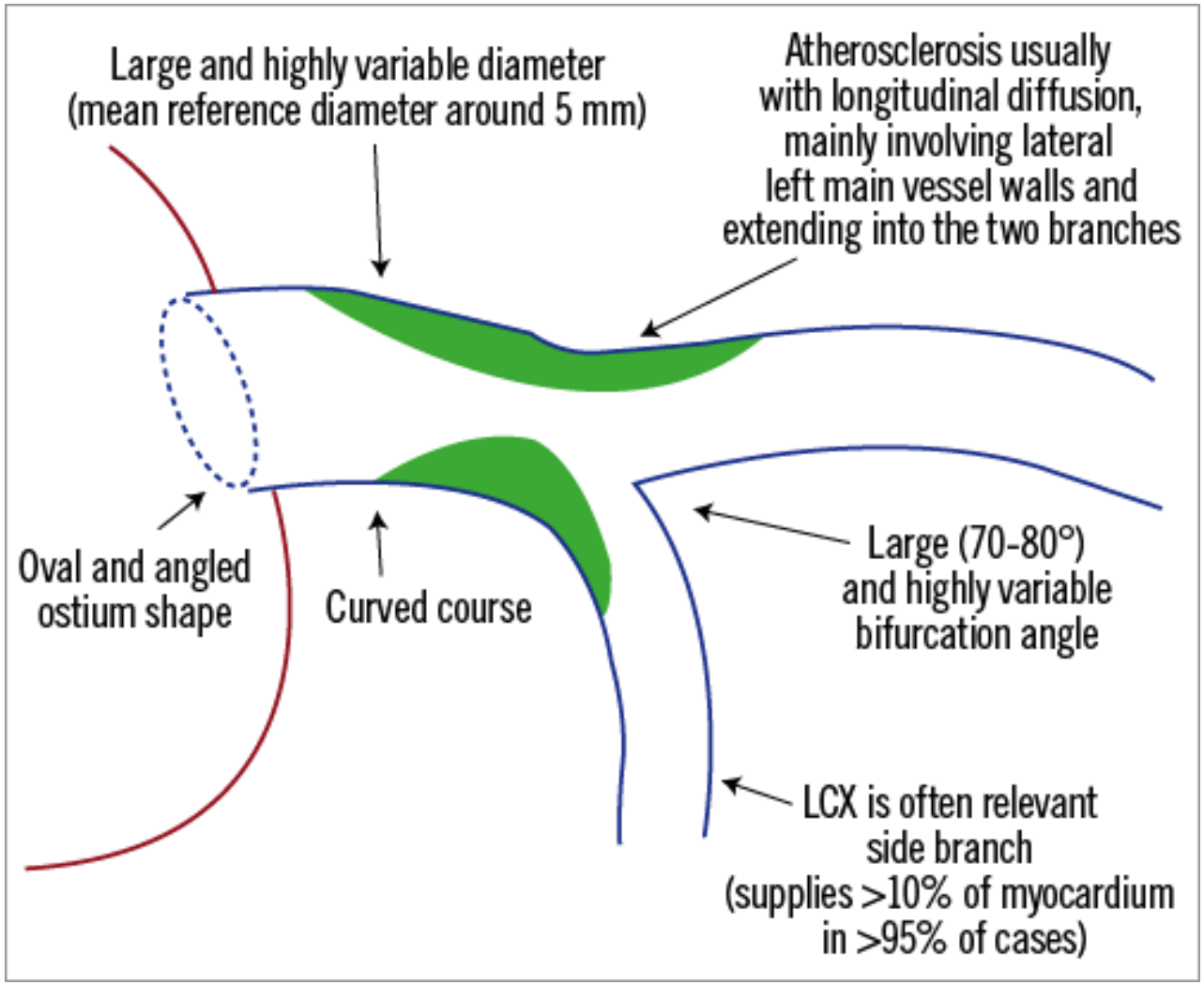
- SYNTAX, STS, Euro II scores
- Number of stents
- Quality of conduits and distal arterial targets
- Completeness of revascularization
- Protective percutaneous VADs

Patients

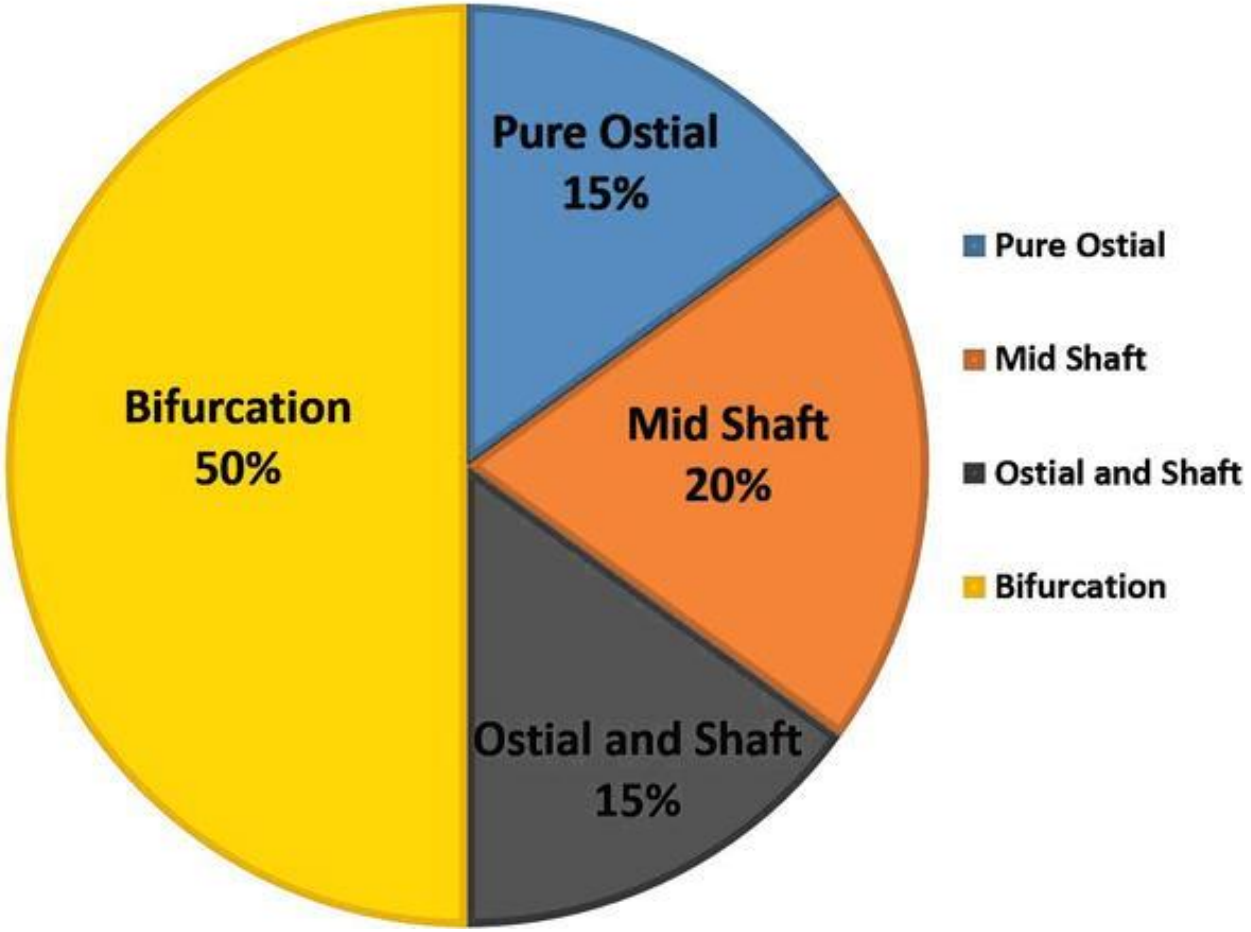
- Personal preferences
- Shared decision-making
- Informed consent

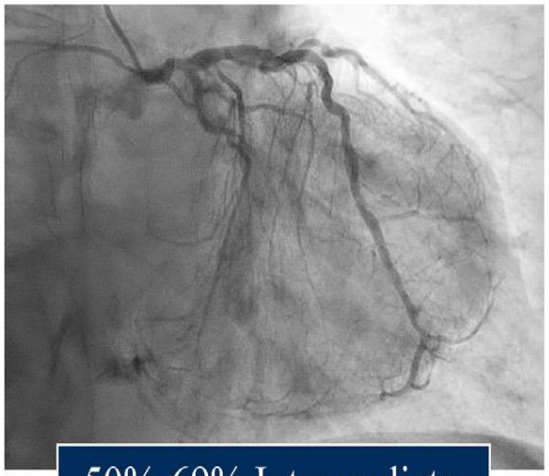
Medical Therapy

- Risk factor control
- Secondary prevention
- Tolerability and adherence to pharmacotherapy

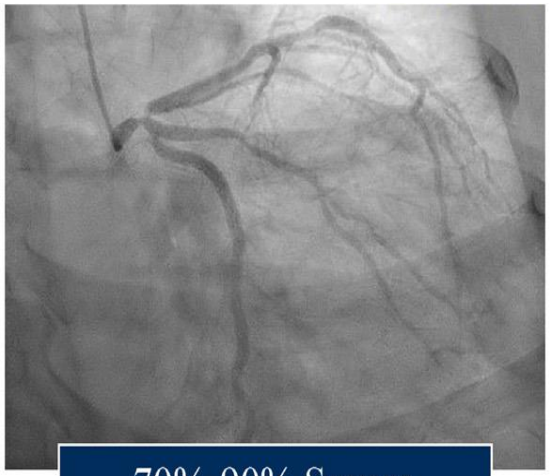

Large and highly variable diameter
(mean reference diameter around 5 mm)
Atherosclerosis usually with longitudinal diffusion, mainly involving lateral left main vessel walls and extending into the two branches
Oval and angled ostium shape
Curved course
Large (70-80°) and highly variable bifurcation angle
LCX is often relevant side branch (supplies >10% of myocardium in >95% of cases)

LEFT MAIN LESION TYPE





50%-69% Intermediate



70%-90% Severe

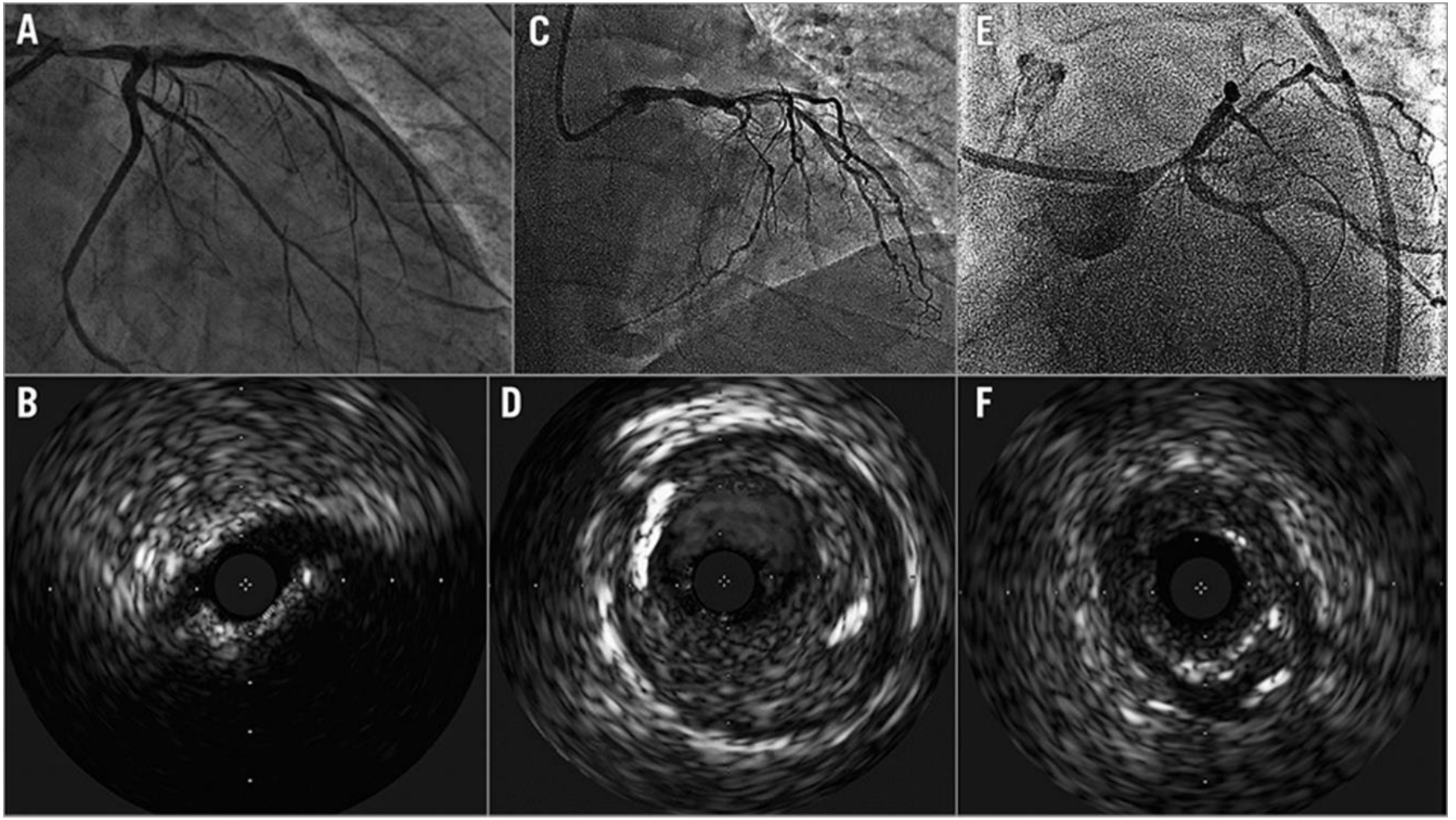
>90% Critical

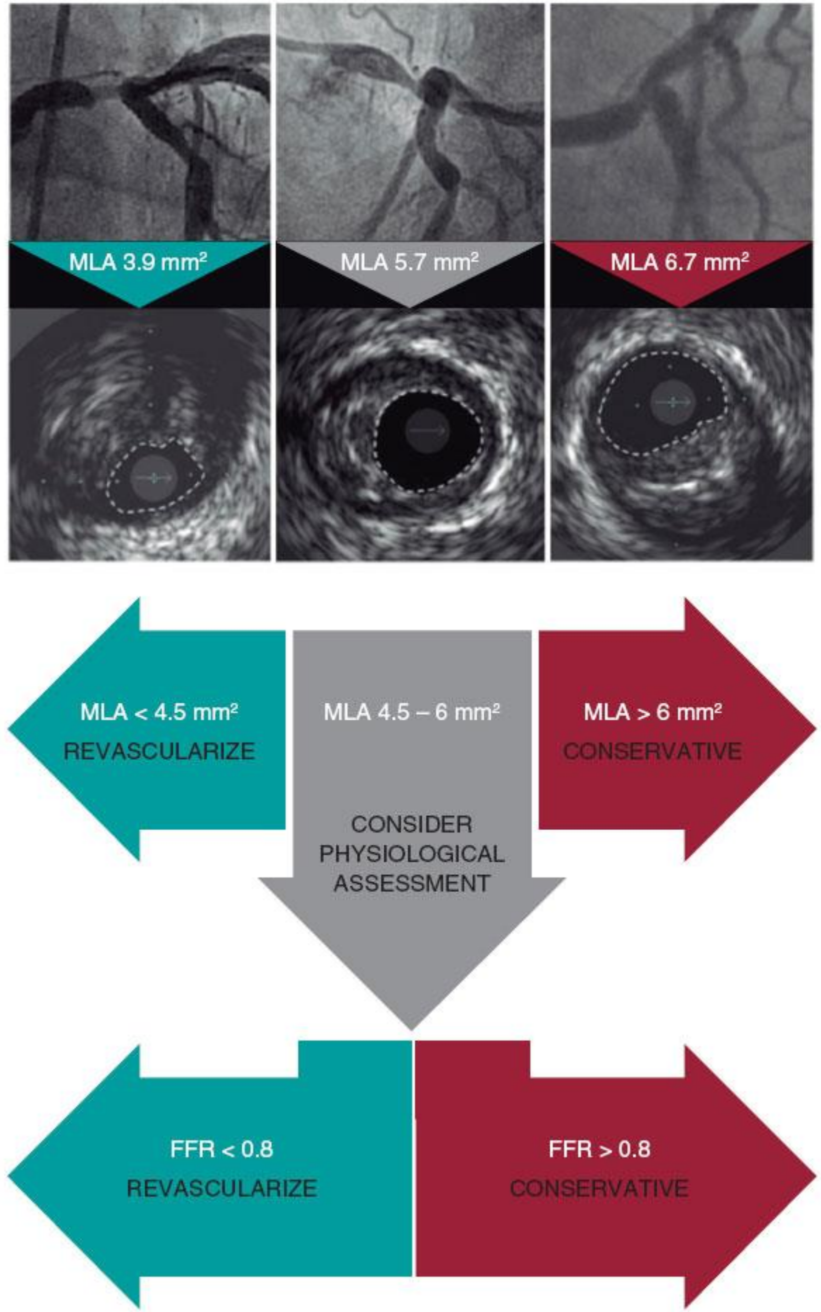
- Visual estimation of angiographic coronary artery percent diameter stenosis ≥50% constituted the original criterion for diagnosing ‘significant LMCA disease.
- However, this criterion is now recognized to be a potentially misleading assessment of coronary anatomy and ischemic risk, especially in patients with **40–69%** LMCA stenosis.

- Studies have shown that IVUS evaluation with deferral of revascularization for lesions with a minimum lumen area of 6–7.5 mm2 is safe.

- Although a smaller cutoff (4.5–4.8 mm2) may be more appropriate in female patients and those of Asian descent.

- Because optical coherence tomography (OCT) requires blood clearance, its effectiveness for imaging the ostial left main (LM) disease is limited.


A
C
E
B
D
F



Rec Interv Cardiol. 2021;3(1):45-54. doi.org/10.24875/RECICE.M20000179

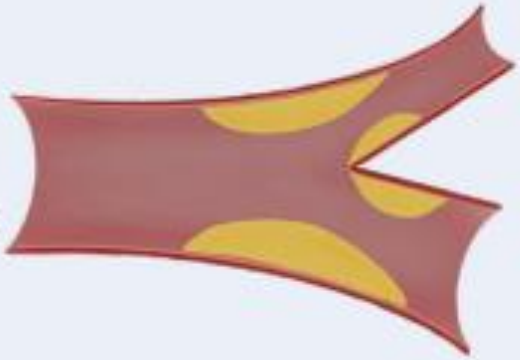
Role of IVUS

Pre-PCI

- Can provide additional information on the ischemic burden of LMCA lesion
- Provide more reliable information on lesion characteristics than angiography
- Helpful in planning PCI strategy (especially for distal LMCA bifurcation lesion)

Post-PCI

- Ensure stent optimization with subsequent postdilatation
- Identify procedural complications



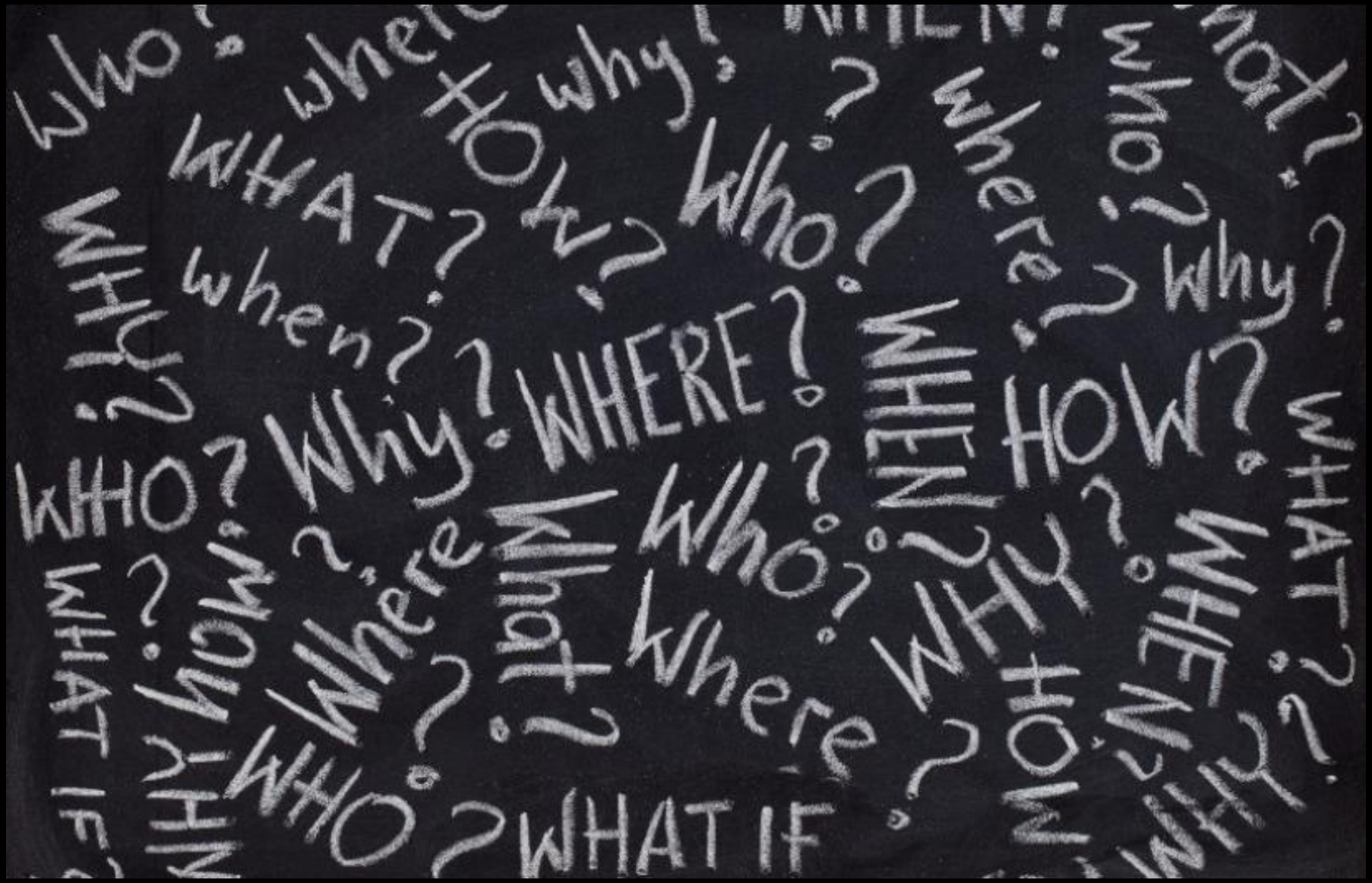
Role of FFR

Pre-PCI

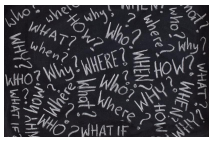
- Provide accurate information on the functional status of angiographic intermediate or ambiguous LMCA lesion

Post-PCI

- Assessment for jailed branches after left main PCI

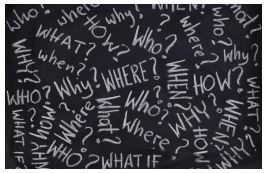

Who?
where?
why?
HOW?
WHAT?
Who?
when?
Why?
WHERE?
WHEN?
WHO?
Where?
What?
Who?
Where?
WHY?
HOW?
WHAT IF

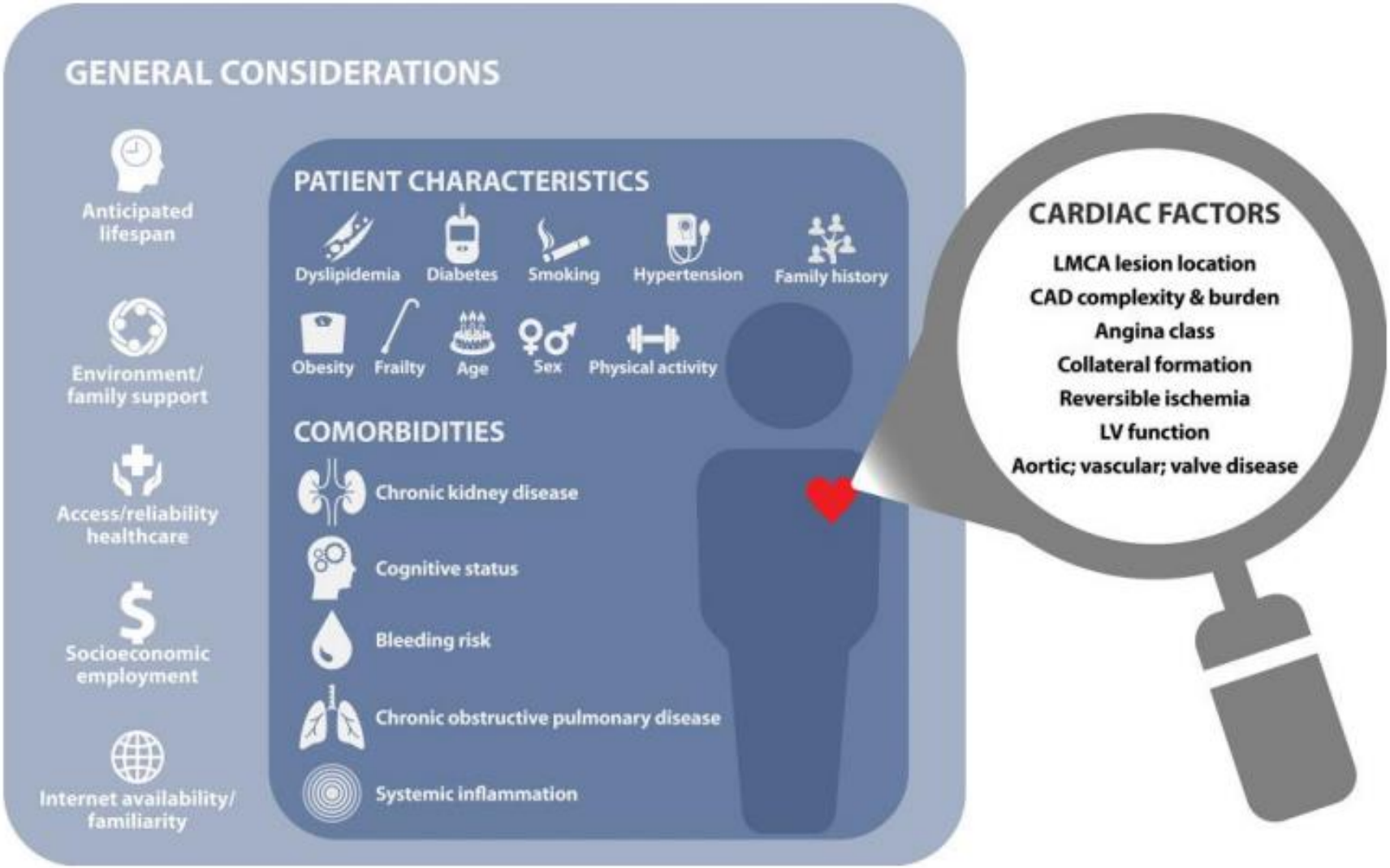
- Whether LMCA risk primarily relates to plaque rupture/thrombosis or is a proxy for a large distal disease burden.
- Whether ostial, shaft, or bifurcation lesion location affects LMCA prognosis.
- Whether CCTA is superior to angiography for assessing anatomy and prognosis.
- Whether stress testing and/or CCTA (with FFR) is preferred over intracoronary physiology (FFR, iFR) for assessing prognosis.
- What constitutes an optimal and cost-effective global method(s) for monitoring restenosis/disease progression.



- Whether OMT permits safe deferral of revascularization for LCMA stenosis < 70%.
- Which combination of medical therapy suits which patient best; What component can be safely deleted when.
- How to personalize patient behavioral changes to achieve sustained adherence to OMT.
- Why discordance exists between symptoms, extent of ischemia, and outcome.
- Why natural history is variable; What are the roles of collaterals and other factors?

- How outcomes 5–10 years after PCI compare with CABG.
- Efficacy and safety of LMCA PCI at hospitals without on-site cardiac surgery.
- Impact of removing provider/institutional economic incentives on treatment choices.
- Efficacy of multiple arterial CABG.
- Reconciling departure from guidelines when local/operator custom/ experience prevails.




GENERAL CONSIDERATIONS
Anticipated lifespan
Environment/ family support
Access/reliability healthcare
Socioeconomic employment
Internet availability/ familiarity
PATIENT CHARACTERISTICS
Dyslipidemia
Diabetes
Smoking
Hypertension
Family history
Obesity
Frailty
Age
Sex
Physical activity
COMORBIDITIES
Chronic kidney disease
Cognitive status
Bleeding risk
Chronic obstructive pulmonary disease
Systemic inflammation
CARDIAC FACTORS
LMCA lesion location
CAD complexity & burden
Angina class
Collateral formation
Reversible ischemia
LV function
Aortic; vascular; valve disease

	SYNTAX[2] (2013)	PRECOMBAT[17] (2011)	EXCEL[18] (2017)	NOBLE[19] (2017)
Sample size	705	600	1,905	1,201
Inclusion criteria	*De novo* LM ≥50% (angiographic assessment) or three-vessel disease	Stable angina or NSTE-ACS LM ≥50% (angiographic assessment)	Stable angina or ACS (including STEMI), LM ≥70% or 50–70% (IVUS or FFR), SYNTAX score ≤32	Stable angina or NSTE-ACS LM ≥50% or FFR ≤80%
Stent	PES	SES	EES	BES (7.7% 1stG)
Syntax score				
PCI	28.4 (11.5)	24.4	20.6±6.2	22.5±7.5
CABG	29.1 (11.4)	25.8	20.5±6.1	22.4±8.0
Distal LM				
PCI	58%	67%	82%	30%
CABG	64%	62%	79%	20%
LVEF				
PCI	<30%: 1%	62 (SD=8)	57 (SD=10)	60 [55–65]
CABG	<30%: 3%	61 (SD=9)	57 (SD=9)	60 [52–64]
IVUS	No	91%	77%	74%
FFR	No	No	9%	No
Primary outcome	Death, MI, RR, stroke NI; 5-year FU (36.9% versus 31%)	Death, MI, TVR stroke; 5-year FU NI (17.5% versus 14.3%)	Death, MI, stroke NI 3-year FU (15.4% versus 14.7%)	Inferior 3-year FU (28% versus 18%)
• Death	NI (12.8% versus 14.6%)	NI (5.7% versus 7.9%)	NI (8.2% versus 5.9%)	NI (11% versus 9%)
• MI	NI (8.2% versus 4.8%)	NI (2% versus 1.7%)	NI (8.3% versus 8%)	Inferior (6% versus 2%)
• RR	Inferior (26.7% versus 15.5%)	Inferior (13% versus 7.3%)	Inferior (12.9% versus 7.6%)	Inferior (15% versus 10%)
• Stroke	Superior (1.5% versus 4.3%)	NI (0.7% versus 0.7%)	NI (2.9% versus 2.3%)	NI (5% versus 2%)

ESC European Society of Cardiology
European Heart Journal (2022) **43**, 4635–4643
https://doi.org/10.1093/eurheartj/ehac542

STATE OF THE ART REVIEW
Acute cardiovascular care

Left main coronary disease: evolving management concepts

ESC European Society of Cardiology
European Heart Journal (2022) **43**, 2421–2424
https://doi.org/10.1093/eurheartj/ehac216

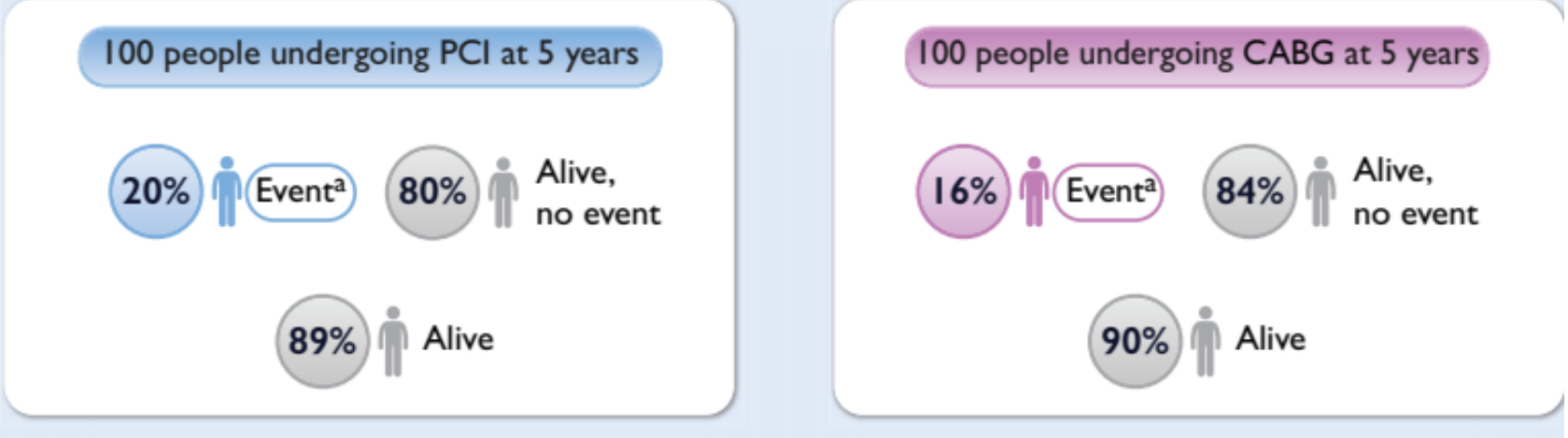
VIEWPOINT
Cardiac and vascular surgery

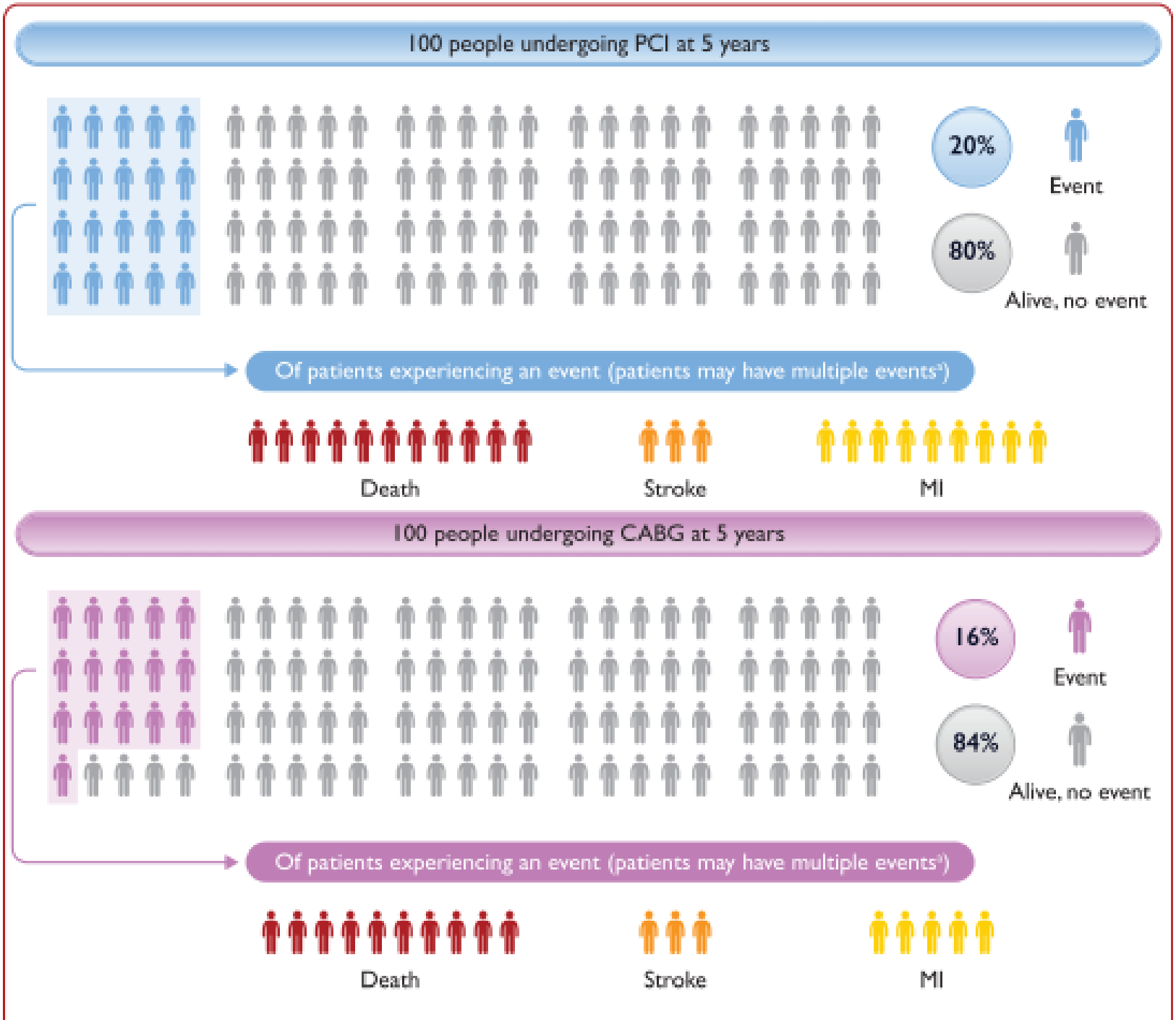
Left main revascularization: an evidence-based reconciliation

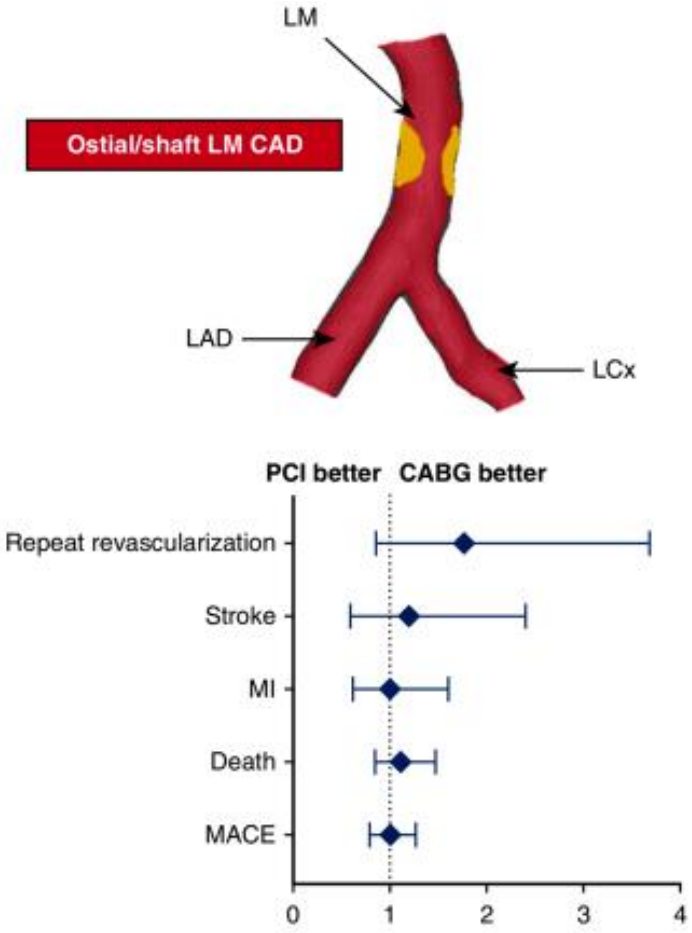
Mario Gaudino [1], Michael E. Farkouh[2], and Gregg W. Stone [3]*

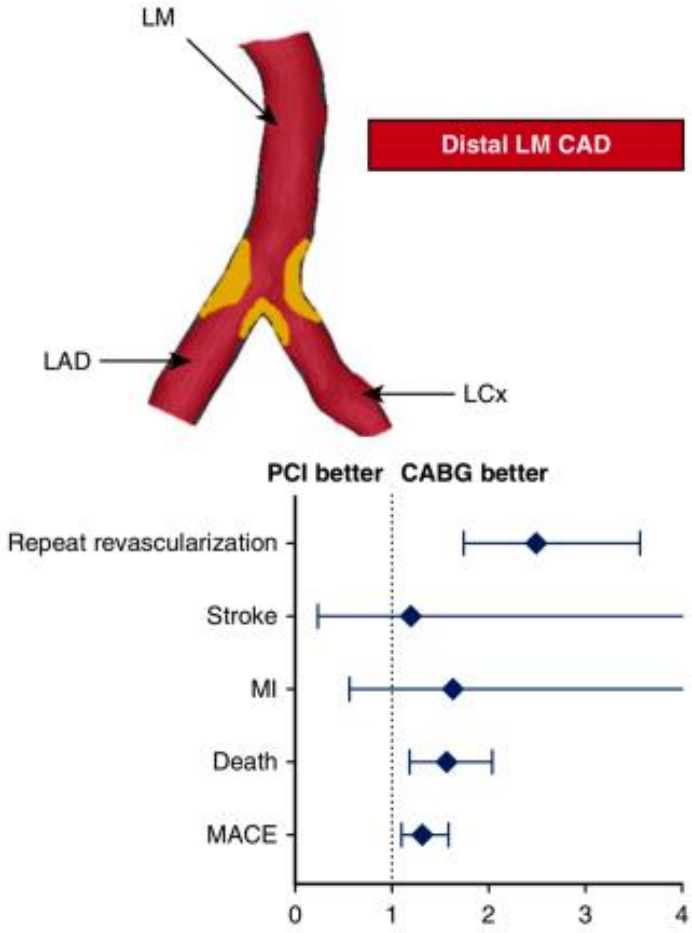
Summary of clinical trial evidence

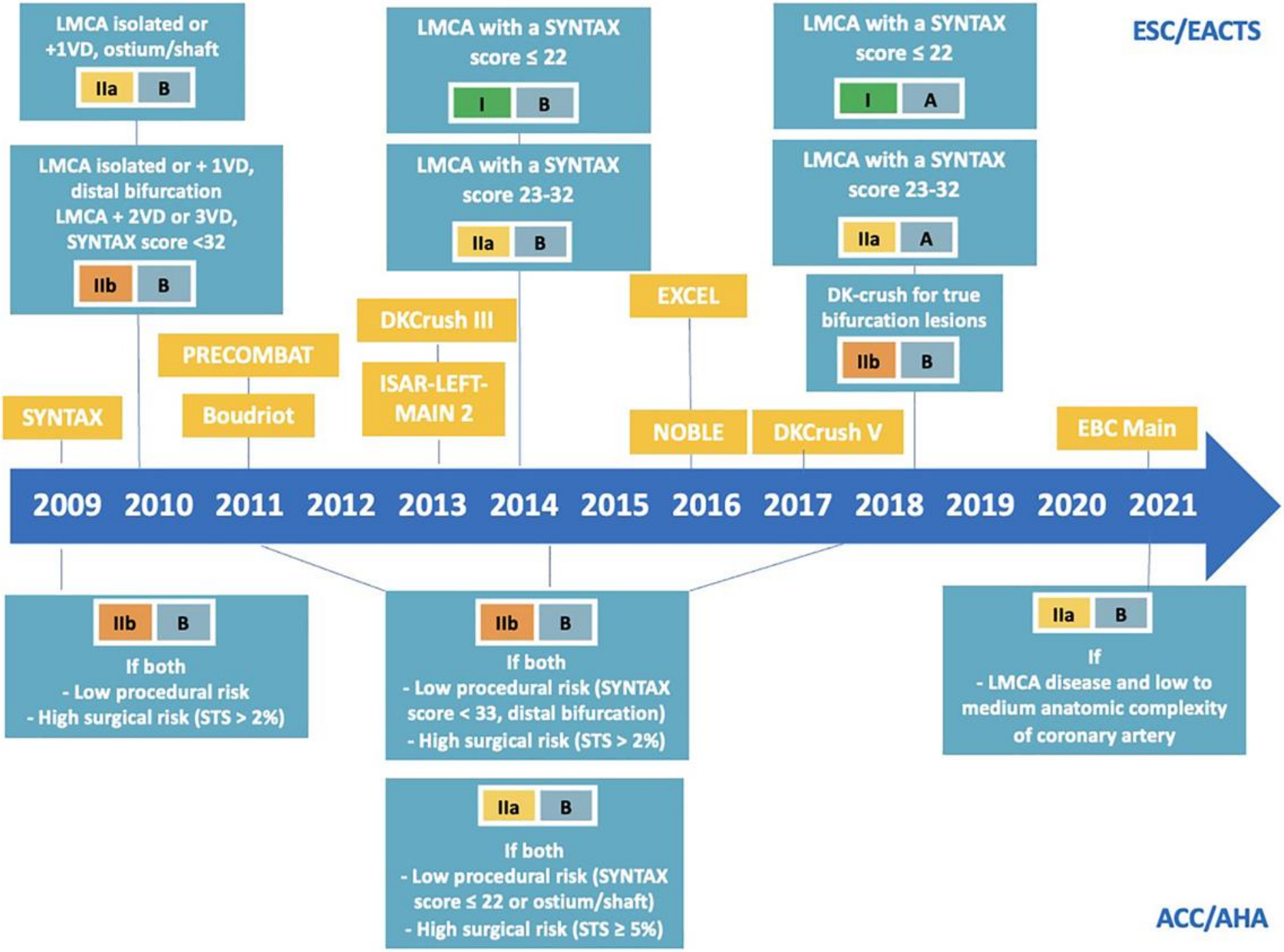
Review of clinical trial evidence for stable patients with left main coronary artery disease, low or intermediate SYNTAX score, low predicted surgical risk, and suitable anatomy for PCI and CABG




100 people undergoing PCI at 5 years
20%
Event
80%
Alive, no event
Of patients experiencing an event (patients may have multiple events[a])
Death
Stroke
MI
100 people undergoing CABG at 5 years
16%
Event
84%
Alive, no event
Of patients experiencing an event (patients may have multiple events[a])
Death
Stroke
MI


LM
Ostial/shaft LM CAD
LAD
LCx
PCI better
CABG better
Repeat revascularization
Stroke
MI
Death
MACE
0
1
2
3
4


LM
Distal LM CAD
LAD
LCx
PCI better
CABG better
Repeat revascularization
Stroke
MI
Death
MACE
0
1
2
3
4


ESC/EACTS
LMCA isolated or +1VD, ostium/shaft
IIa B
LMCA isolated or + 1VD, distal bifurcation LMCA + 2VD or 3VD, SYNTAX score <32
IIb B
LMCA with a SYNTAX score ≤ 22
I B
LMCA with a SYNTAX score 23-32
IIa B
LMCA with a SYNTAX score ≤ 22
I A
LMCA with a SYNTAX score 23-32
IIa A
DK-crush for true bifurcation lesions
IIb B
SYNTAX
PRECOMBAT
Boudriot
DKCrush III
ISAR-LEFT-MAIN 2
EXCEL
NOBLE
DKCrush V
EBC Main
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
IIb B
If both
- Low procedural risk
- High surgical risk (STS > 2%)
IIb B
If both
- Low procedural risk (SYNTAX score < 33, distal bifurcation)
- High surgical risk (STS > 2%)
IIa B
If both
- Low procedural risk (SYNTAX score ≤ 22 or ostium/shaft)
- High surgical risk (STS ≥ 5%)
IIa B
If
- LMCA disease and low to medium anatomic complexity of coronary artery
ACC/AHA

Risk scores

- STS (Society of Thoracic Surgeons)
- Euro SCORE II (European System for Cardiac Operative Risk Evaluation)
- NCDR(National Cardiovascular Data Registry)
- Cath PCI Registry.
- SYNTAX (Synergy Between PCI with Taxus and Cardiac Surgery) score
- More recent SYNTAX II 2020

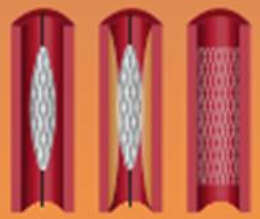
		Favours PCI	Favours CABG
Clinical characteristics	Advanced age/frailty/reduced life expectancy	✓	
	Severe co-morbidity (not adequately reflected by scores)	✓	
	High surgical risk	✓	
	Reduced LVEF <35%		✓
	Diabetes		✓
	Contraindication for DAPT		✓
	Recurrent diffuse in-stent restenosis		✓
	Prior CABG 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		✓

Favors OMT

- Minimal symptoms
- Good quality of life
- Tolerates medical therapy and reaches target goals
- Adheres to careful follow-up
- Patient preference

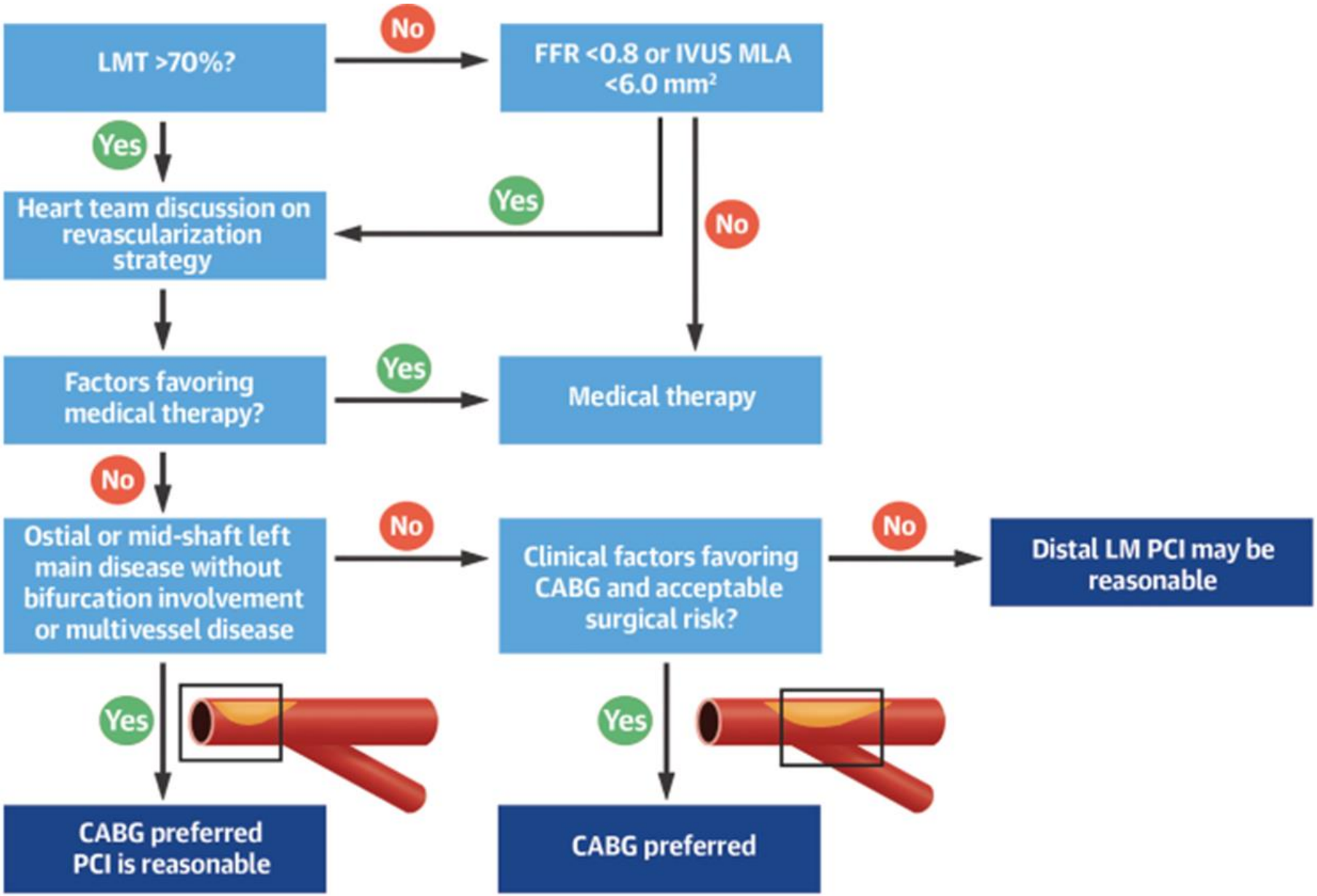
Favors PCI

- High surgical risk
- Low complexity plaques
- Low quality CABG conduits
- Elderly patients with serious comorbidities
- Preference for fast recovery



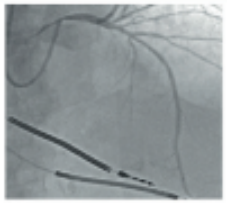
Favors CABG

- Diabetes
- Complex MVD
- Moderate/severe LV dysfunction
- Requires concomitant cardiac surgery
- Long term survival

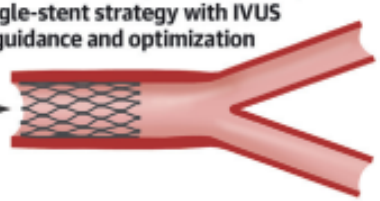

LMT >70%?
No
FFR <0.8 or IVUS MLA <6.0 mm²
Yes
Heart team discussion on revascularization strategy
Yes
No
Factors favoring medical therapy?
Yes
Medical therapy
No
Ostial or mid-shaft left main disease without bifurcation involvement or multivessel disease
No
Clinical factors favoring CABG and acceptable surgical risk?
No
Distal LM PCI may be reasonable
Yes
CABG preferred PCI is reasonable
Yes
CABG preferred

Left Main PCI and Lesion Anatomy, Morphology, and Complexity: Technical Considerations for PCI in Left Main Disease

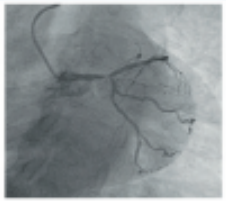
Ostial or mid-shaft (nonbifurcation)

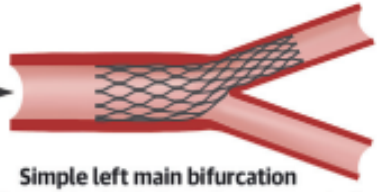


Ostial or mid-shaft (nonbifurcation): Single-stent strategy with IVUS guidance and optimization

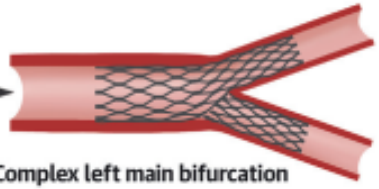


Distal left main bifurcation (eg Medina 1,1,1 or 0,1,1)

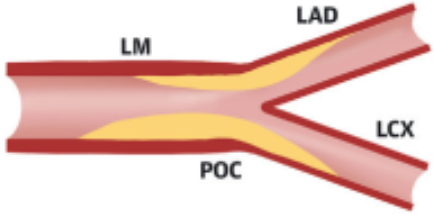




Simple left main bifurcation (and low-risk of side branch compromise): Provisional single-stent strategy with IVUS guidance or optimization

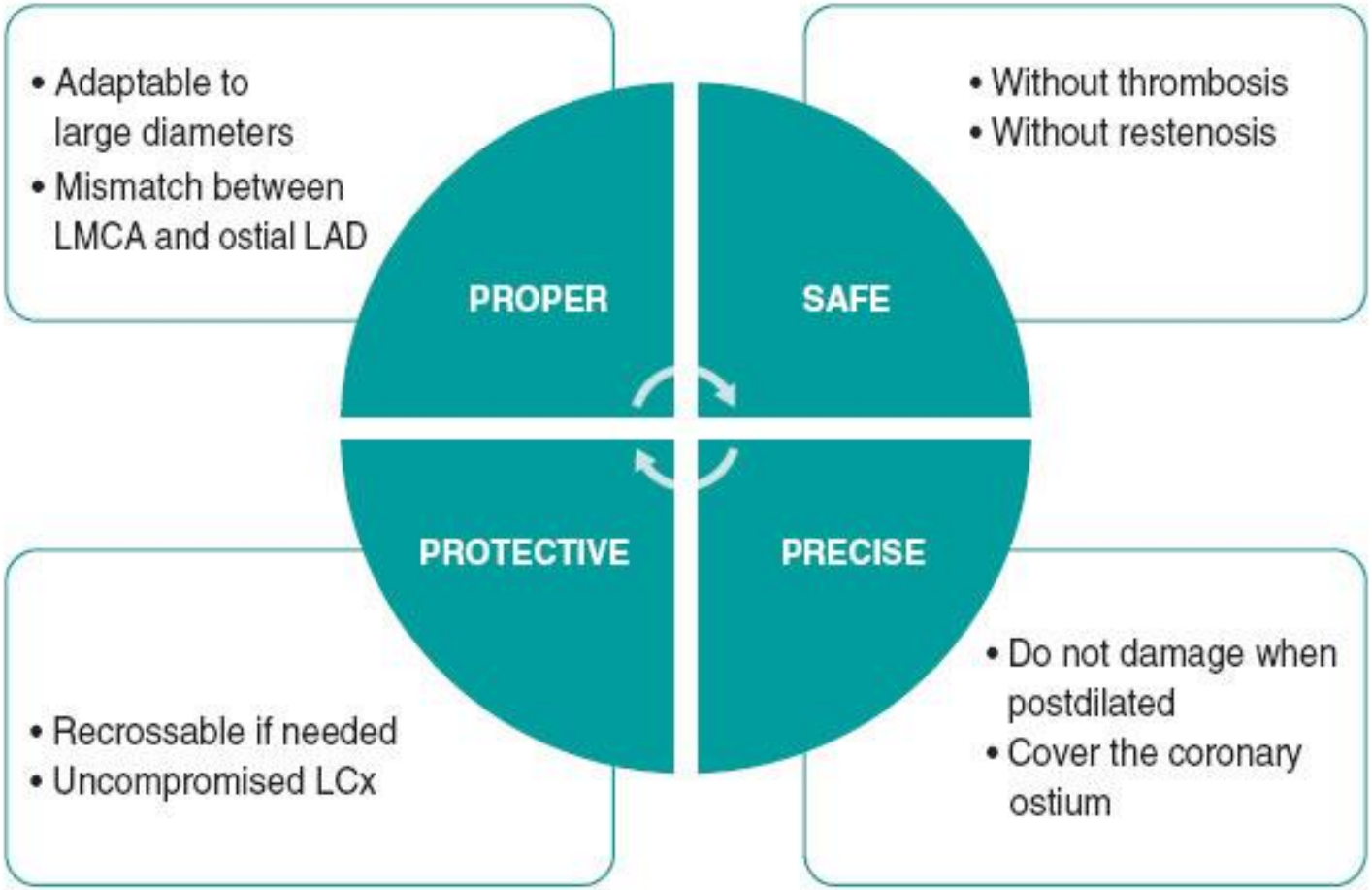


Complex left main bifurcation (and high-risk of side branch compromise): Up-front 2-stent strategy (eg, DK-Crush, Culotte, T-and-Protrusion) with IVUS guidance and optimization to include KBI and POT



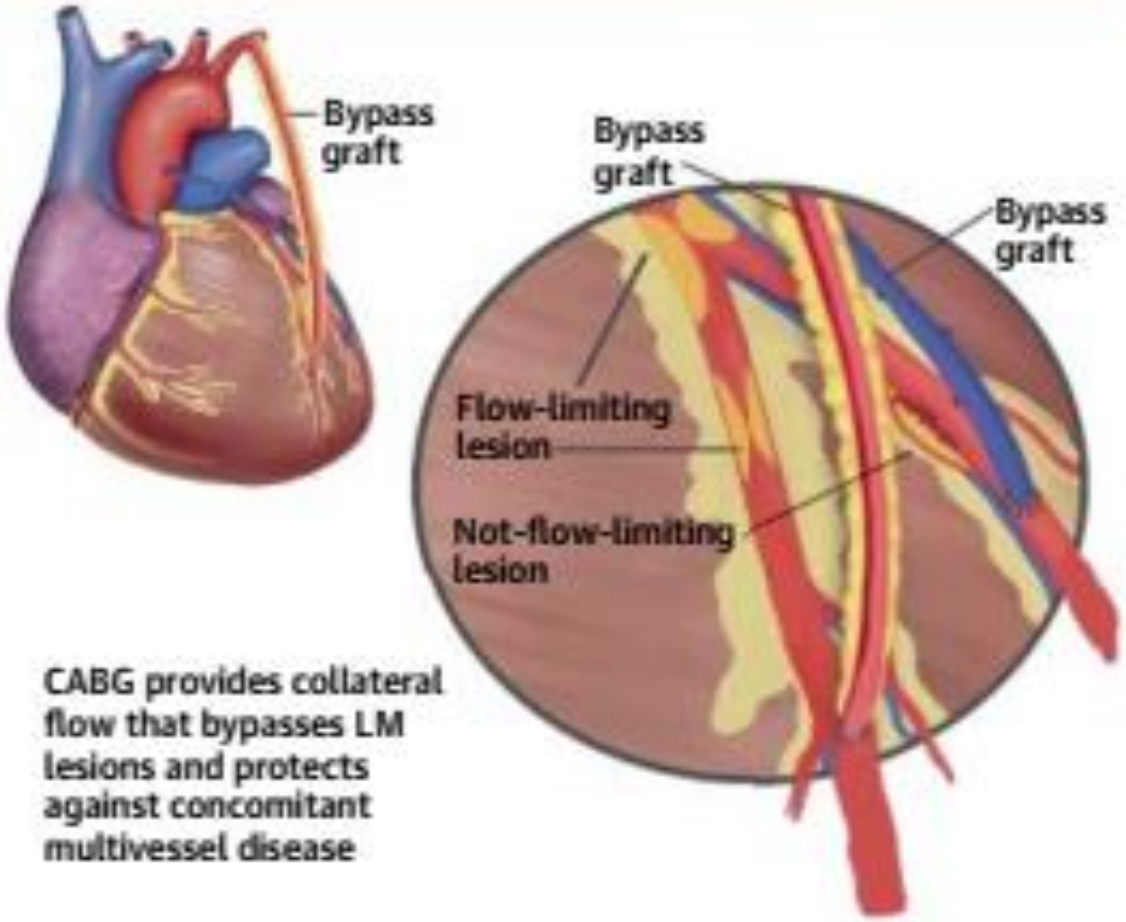
Left main coronary artery lesion angiography and intravascular imaging characteristics include:

- Lesion length
- Lesion diameter
- Lesion location (eg, shaft vs bifurcation)
- Bifurcation vessel (eg, LAD and/or LCX) involvement
- Bifurcation angle
- Plaque burden and morphology (eg, calcification)

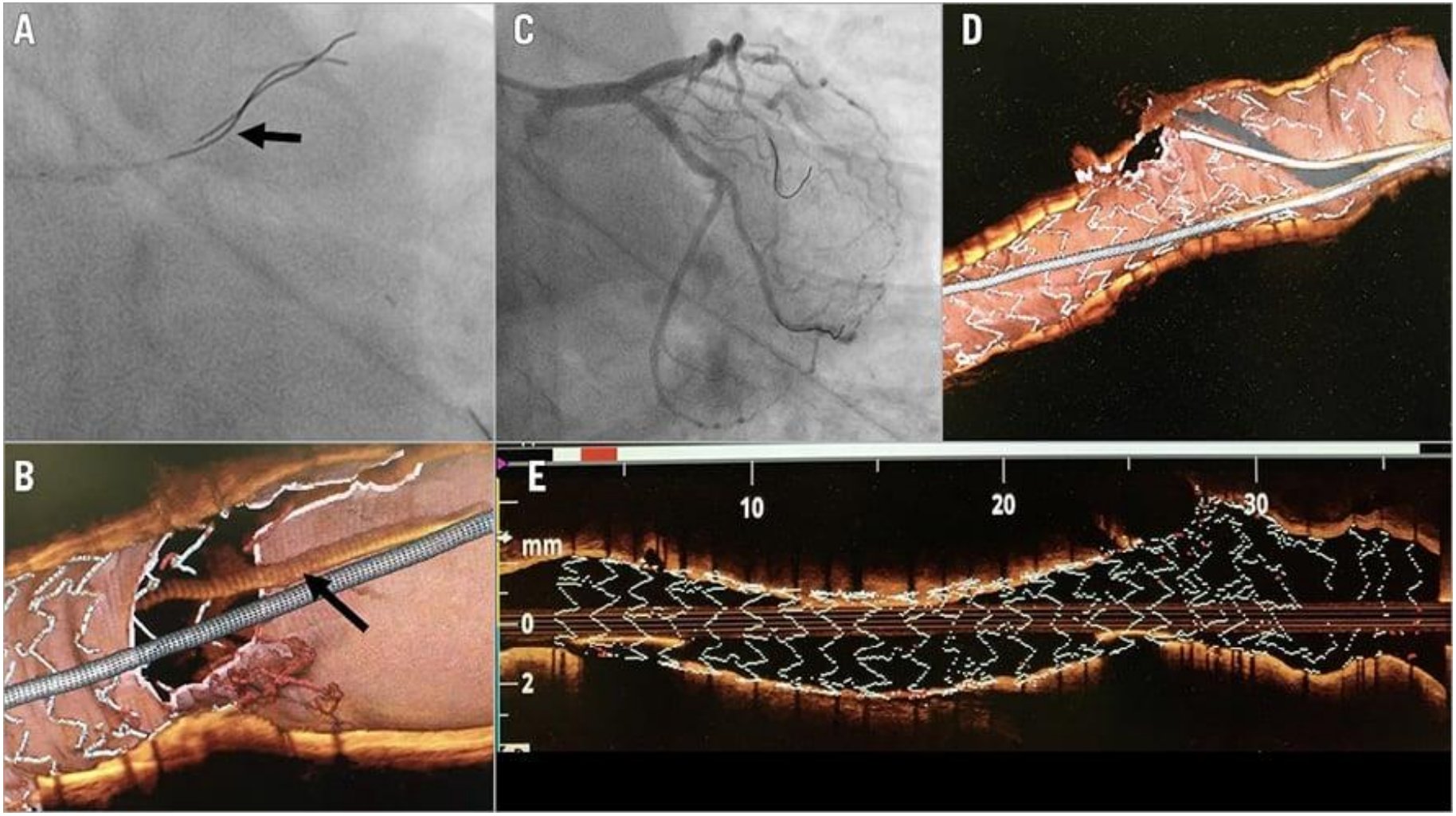


Rec Interv Cardiol. 2021;3(1):45-54. doi.org/10.24875/RECICE.M20000179

Coronary Artery Bypass Grafting



CABG provides collateral flow that bypasses LM lesions and protects against concomitant multivessel disease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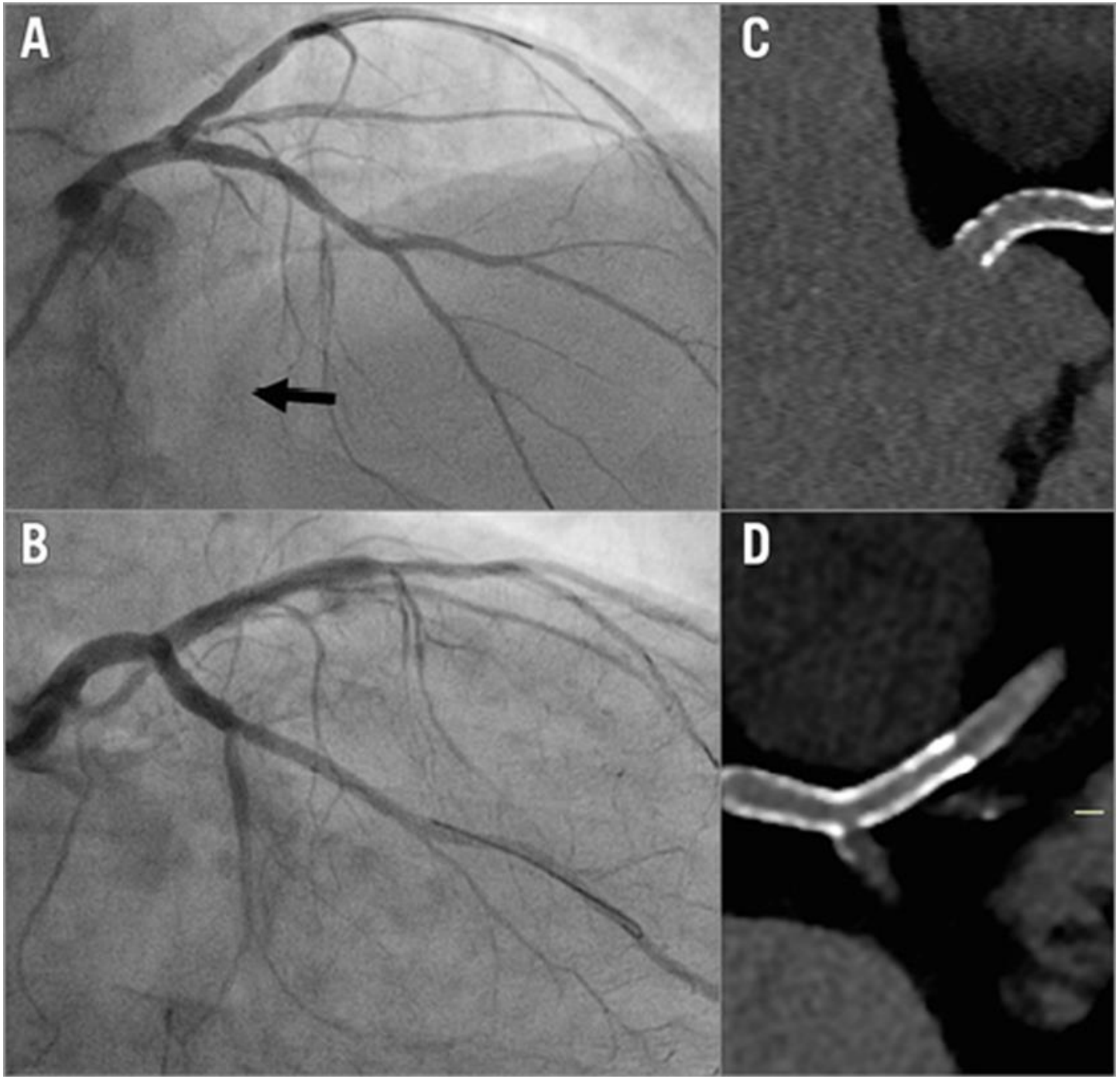
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Study description	Intervention	Measurement	Timelines
Optimization of Left Main PCI with Intravascular Ultrasound. The OPTIMAL Randomized Controlled Trial (OPTIMAL, NCT04111770) Sample Size: 800	Interventional; Intravascular ultrasound (IVUS)-guided PCI vs. qualitative coronary angiography (QCA) guided PCI	All-cause death, any stroke, any myocardial infarction (MI), any clinically indicated revascularization at 2-year follow-up	Status: Recruiting Estimated study completion: July 2024; 2-year follow-up
Concordance Between FFR and iFR for the Assessment Intermediate Lesions in LMCA. A Prospective Validation of a Default Value for iFR (iLITRO, NCT03767621) Sample Size: 300	Observational (patient registry); indication of revascularization	Assess correlation between FFR ≥0.80 and iFR ≥ 0.89 (1 day); major adverse cardiac events: death, MI, unplanned revascularization (30 days,1 year, 5 years)	Status: Recruiting Estimated study completion: November 2025; 5-year follow-up
Angiographic Evaluation LMCA Intervention (ANGELINE, NCT04604197) Sample Size: 400	Post PCI, angiographic follow-up at 6 months and clinical follow-up at 36 months vs. clinical follow-up at 36 months	Death, MI and stroke at 36 months	Status: Recruiting Estimated study completion: December 2025; 3-year follow-up
Comparison of Optical Coherence Tomography-derived Minimal Lumen Area, Invasive Fractional Flow Reserve and FFRCT (OPTICO-LM, NCT03820492) Sample Size: 104	Assessment of intermediate LMCA stenosis: comparison of OCT derived minimal lumen area (MLA), FFR and computed tomography (FFR_{CT})	OCT vs. FFR under the curve of OCT-derived MLA for FFR ≤0.8 and optimal cut-off of OCT-derived MLA from ROC's for FFR ≤0.8; FFRCT vs. FFR positive predictive value (PPV) and negative predictive value (NPV) of FFR_{CT} ≤0.8 for FFR ≤0.8	Status: Recruiting Estimated study completion: December 2023; 1-year follow-up
Long-term Outcomes Following PCI vs. CABG for Treating In-stent Restenosis in Unprotected LMCA: Multicentre LM-DRAGON Registry (LM-DRAGON, NCT04968977) Sample Size: 305	Observational (patient registry); PCI vs. CABG	Major adverse cardiovascular and cerebrovascular event (MACCE)	Status: Completed Completion Date: June 2021; 4-year follow-up

Reference

- A practical approach to left main coronary artery disease: JACC state-of-the-art review. Journal of the American College of Cardiology. 2022 Nov 29;80(22):2119-34.

- Left main coronary artery disease: secular trends in patient characteristics, treatments, and outcomes. Journal of the American College of Cardiology. 2016 Sep 13;68(11):1233-46.

- Evidence-based Management of Left Main Coronary Artery Disease. European Cardiology Review. 2023;18.

- Left Main Coronary Artery Disease—Current Management and Future Perspectives. Journal of Clinical Medicine. 2022 Sep 28;11(19):5745.

Anatomy

- Ostial/shaft vs bifurcation
- Simple vs complex
- 50-70% DS vs 70-95% DS
- Intravascular ultrasound diameter

Physiology

- Ischaemic symptoms
- Ischaemic stress test
- Ischaemic FFR/iFR

Natural History

- Risk scores
- Life expectancy
- Progression of disease
- Success of medical therapy

Interventionalist/Surgeon

- Volume
- Expertise
- Experience

Heart Team

- Interventional cardiologist
- Clinical cardiologist
- Cardiac surgeon
- Allied health professional

Hospital

- Health care system and resources
- On-site vs off-site CABG
- PCI/CABG volume and outcomes
- Functional heart team
- Rehab program

Provider-Patient-Institutional Axis

PCI/CABG

- SYNTAX, STS, Euro II scores
- Number of stents
- Quality of conduits and distal arterial targets
- Completeness of revascularization
- Protective percutaneous VADs

Patients

- Personal preferences
- Shared decision-making
- Informed consent

Medical Therapy

- Risk factor control
- Secondary prevention
- Tolerability and adherence to pharmacotherapy


Thank You
for your attention