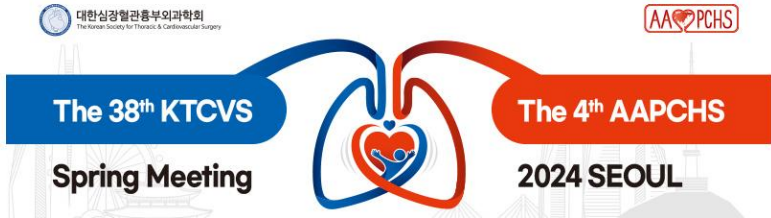
Current guidelines for surgical coronary revascularization – strength and weakness

Do Jung Kim

Department of thoracic and cardiovascular surgery
Ajou University Hospital, Ajou University School of Medicine

아주대학교의료원
Ajou University Medical Center



Current Guidelines on Surgical Coronary Revascularization

ESC European Society of Cardiology
European Heart Journal (2019) **40**, 87–165
doi:10.1093/eurheartj/ehy394

ESC/EACTS GUIDELINES

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)

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
VOL. 79, NO. 2, 2022

PUBLISHED BY ELSEVIER

CLINICAL PRACTICE GUIDELINE: EXECUTIVE SUMMARY

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization: Executive Summary

A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

CLINICAL PRACTICE GUIDELINE

VOL. 82, NO. 9, 2023

2023 AHA/ACC/ACCP/ASPC/NLA/PCNA Guideline for the Management of Patients With Chronic Coronary Disease

A Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines

Developed in Collaboration With and Endorsed by the American College of Clinical Pharmacy, American Society for Preventive Cardiology, National Lipid Association, and Preventive Cardiovascular Nurses Association

아주대학교의료원
Ajou University Medical Center

대한심장혈관흉부외과학회
The Korean Society for Thoracic & Cardiovascular Surgery

Guidelines on Surgical Coronary Revascularization

Strengths of Guidelines

- Evidence-Based Recommendations.
  - Recommendations based on the latest research and clinical trials
  - SYNTAX, PRECOMBAT, NOBLE, EXCEL
- Standardization.
  - Provides uniformity in treatment approaches.
- Comprehensive Care (Inclusive recommendations for various patient groups)
  - Recommendations based on different risk groups and anatomical complexities
  - Emphasis on personalized patient care
- Multidisciplinary Approach.
  - Collaboration among cardiac surgeons, cardiologists, and other specialists

Guidelines on Surgical Coronary Revascularization

Weaknesses of Guidelines

- Research Limitations
  - Insufficient reflection of the most recent studies
  - Sample size and scope limitations in some studies
- Variability in Implementation.
  - Differences in adherence to guidelines across different regions and institutions
  - Limited data on specific groups such as women, elderly, and minorities
- Limited Flexibility.
  - Inadequate reflection of individual patient characteristics
  - Challenges in applying to diverse clinical scenarios
- Update Delays.
  - Lag between new research findings and guideline updates

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

Improving Equity of Care in Revascularization

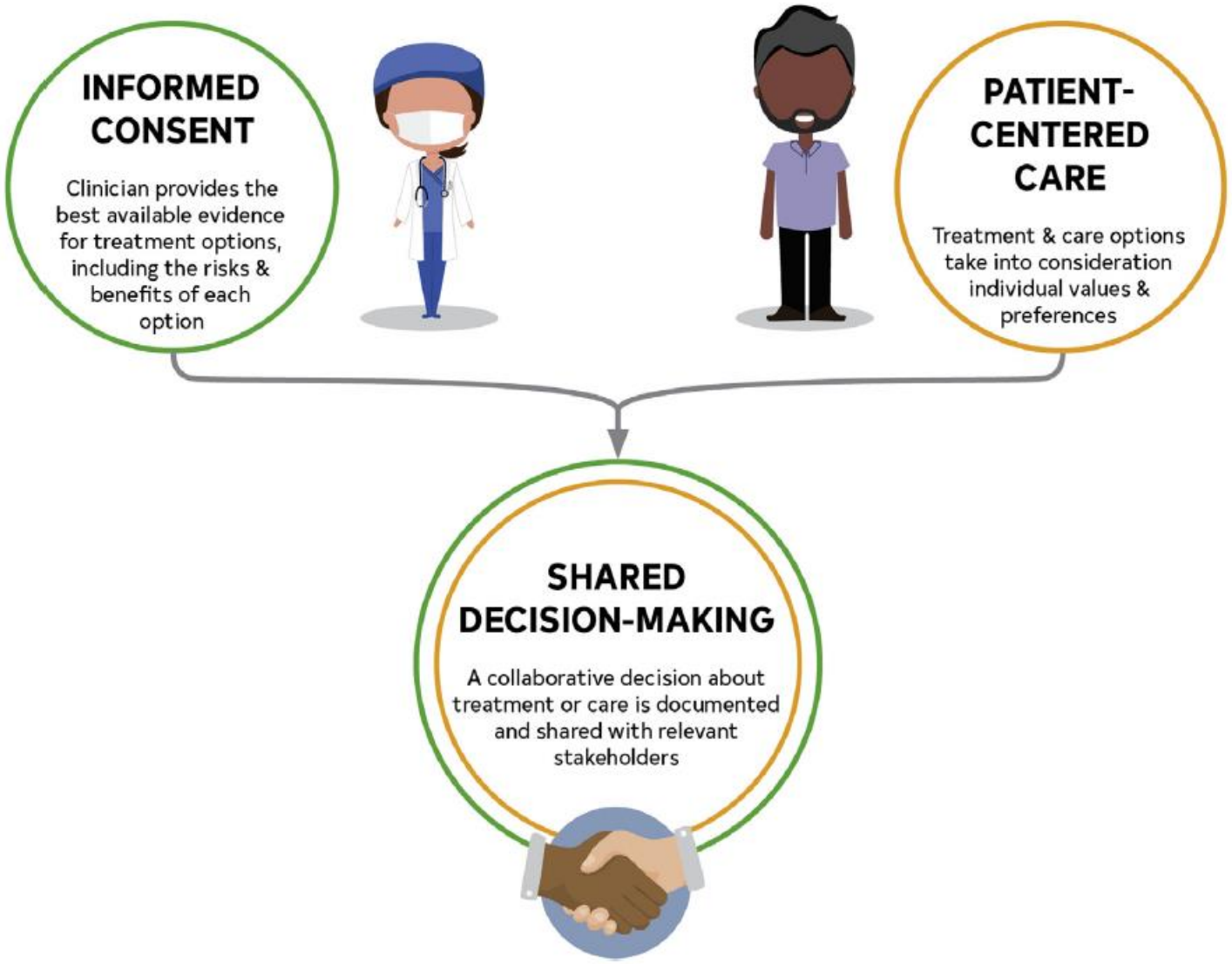
COR	LOE	RECOMMENDATION	TAKE-HOME MESSAGE NO. 1
1	B-NR	1. In patients who require coronary revascularization, treatment decisions should be based on clinical indication, regardless of sex (9-15), or race or ethnicity (16-18), and efforts to reduce disparities of care are warranted (19,20).	

Shared Decision-Making and Informed Consent

COR	LOE	RECOMMENDATION	TAKE-HOME MESSAGE NO. 2
1	C-LD	1. In patients undergoing revascularization, decisions should be patient-centered—that is, considerate of the patient's preferences and goals, cultural beliefs, health literacy, and social determinants of health—and made in collaboration with the patient's support system (27,28).	
1	C-LD	2. In patients undergoing coronary angiography or revascularization, adequate information about benefits, risks, therapeutic consequences, and potential alternatives in the performance of percutaneous and surgical myocardial revascularization should be given, when feasible, with sufficient time for informed decision-making to improve clinical outcomes (29-31).	

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

FIGURE 2 Shared Decision-Making Algorithm



2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

Heart team approach

COR	LOE	RECOMMENDATION
1	B-NR	1. In patients where the optimal treatment strategy is unclear, a Heart Team approach that includes representatives from interventional cardiology, cardiac surgery, and clinical cardiology is recommended to improve patient outcomes (21-26).

TAKE-HOME MESSAGE NO. 2

TABLE 2 Factors for Consideration by the Heart Team

Coronary Anatomy
■ Left main disease
■ Multivessel disease
■ High anatomic complexity (i.e., bifurcation disease, high SYNTAX score)
Comorbidities
■ Diabetes
■ Systolic dysfunction
■ Coagulopathy
■ Valvular heart disease
■ Frailty
■ Malignant neoplasm
■ End-stage renal disease
■ Chronic obstructive pulmonary disease
■ Immunosuppression
■ Debilitating neurological disorders
■ Liver disease/cirrhosis
■ Prior CVA
■ Calcified/porcelain aorta
■ Aortic aneurysm

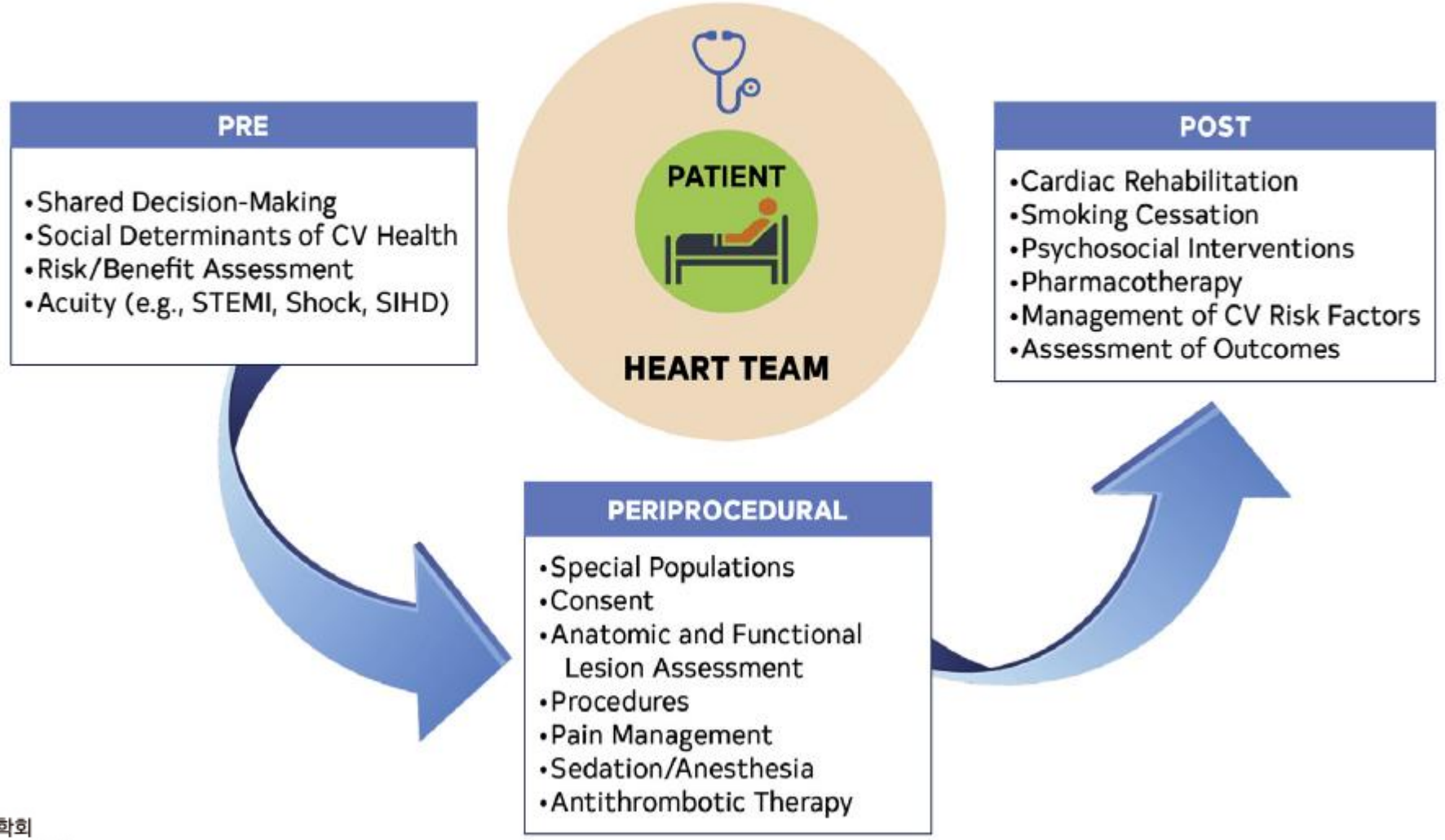
TABLE 2 Continued

Procedural Factors
■ Local and regional outcomes
■ Access site for PCI
■ Surgical risk
■ PCI risk
Patient Factors
■ Unstable presentation or shock
■ Patient preferences
■ Inability or unwillingness to adhere to DAPT
■ Patient social support
■ Religious beliefs
■ Patient education, knowledge, and understanding

CVA indicates cerebrovascular accident; DAPT, dual antiplatelet therapy; PCI, percutaneous coronary intervention; and SYNTAX, Synergy Between PCI With TAXUS and Cardiac Surgery.

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

FIGURE 1 Phases of Patient-Centric Care in the Treatment of Coronary Artery Disease



2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

Revascularization to Improve Survival in SIHD Compared With Medical Therapy

- Left main stenosis

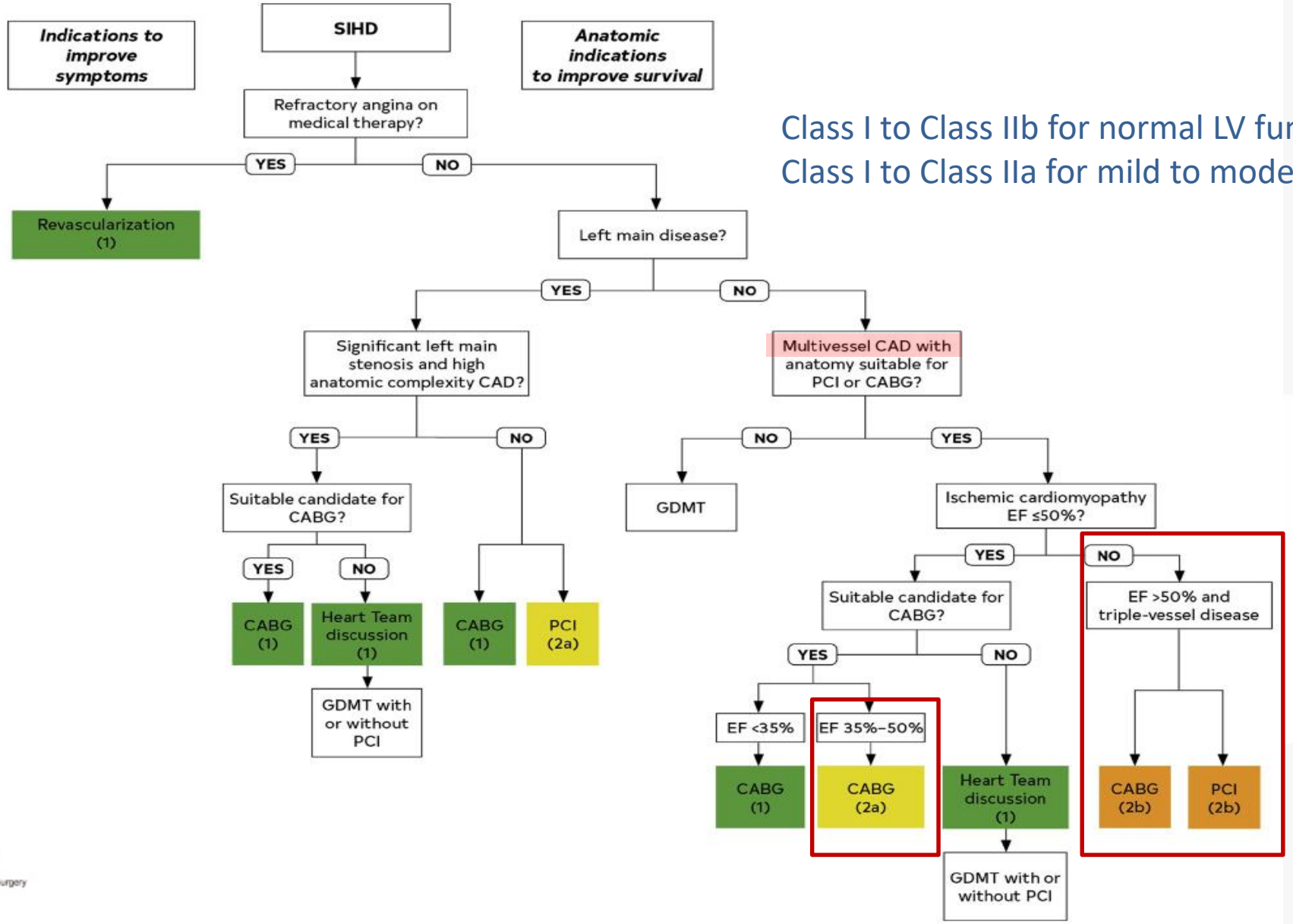
COR	LOE	RECOMMENDATIONS	TAKE-HOME MESSAGE NO. 3
1	B-R	1. In patients with SIHD and significant left main stenosis, CABG is recommended to improve survival (36-39).	
2a	B-NR	2. In selected patients with SIHD and significant left main stenosis for whom PCI can provide equivalent revascularization to that possible with CABG, PCI is reasonable to improve survival (36).	

- multi-vessel disease

COR	LOE	RECOMMENDATIONS	TAKE-HOME MESSAGE NO. 4
2b	B-R	1. In patients with SIHD, normal ejection fraction, significant stenosis in 3 major coronary arteries (with or without proximal LAD), and anatomy suitable for CABG, CABG may be reasonable to improve survival (37,40,50,51).	
2b	B-R	2. In patients with SIHD, normal ejection fraction, significant stenosis in 3 major coronary arteries (with or without proximal LAD), and anatomy suitable for PCI, the usefulness of PCI to improve survival is uncertain (50-60).	

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

- Revascularization in Patients With Stable Ischemic Heart Disease



Class I to Class IIb for normal LV function.
Class I to Class IIa for mild to moderate LV dysfunction.

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

- Revascularization to Improve Survival in SIHD Compared with Medical Therapy.

5. The new Class 2b recommendation, which represents a downgrade from a Class 1 recommendation in the 2011 CABG guideline (56), reflects new evidence showing no advantage of CABG over medical therapy alone to improve survival in patients with 3-vessel CAD with preserved LV function and no LM disease. The older recommendation was based on evidence from registry studies (26,29,48,57), a meta-analysis (10), and a single RCT (13), all of which were completed >20 to 40 years ago before the development of newer surgical techniques or advances in medical therapy associated with improved prognosis (58,59). Newer evidence from the ISCHEMIA trial (14) and from meta-analyses, which incorporated (15,60-62) or did not incorporate (37) the ISCHEMIA results, as well as a more detailed review of earlier studies (63) supported this downgrade. After several hours of deliberation, the writing committee concluded that using CABG as a revascularization strategy versus medical therapy alone "may be reasonable" to improve survival in stable patients with 3-vessel CAD. The writing committee recognized that an adequately powered trial to test this hypothesis is unfeasible in the current era but proposed that revascularization confers other benefits to patients with multivessel CAD and SIHD. Accordingly, Section 7.3. highlights the advantages of revascularization over medical therapy for the prevention of cardiovascular events.

2012 Guideline for the Diagnosis and Management for Patients with SIHD

3-vessel disease with or without proximal LAD artery disease*		
CABG	I	B
	IIa—It is reasonable to choose CABG over PCI in patients with complex 3-vessel CAD (e.g., SYNTAX score >22) who are good candidates for CABG.	B
PCI	IIb—Of uncertain benefit	B

2011 Guideline for Coronary Artery Bypass Graft Surgery

Non–Left Main CAD Revascularization

CLASS I

1. CABG to improve survival is beneficial in patients with significant (≥70% diameter) stenoses in 3 major coronary arteries (with or without involvement of the proximal LAD artery) or in the proximal LAD plus 1 other major coronary artery (314,318,341–344). *(Level of Evidence: B)*

CLASS IIa

4. It is reasonable to choose CABG over PCI to improve survival in patients with complex 3-vessel CAD (e.g., SYNTAX score >22), with or without involvement of the proximal LAD artery, who are good candidates for CABG (320,334,343,359–360). *(Level of Evidence: B)*

Do not Endorse 2021 Coronary Revascularization Guidelines

The American Association for Thoracic Surgery and The Society of Thoracic Surgeons reasoning for not endorsing the 2021 ACC/AHA/SCAI Coronary Revascularization Guidelines

Joseph F. Sabik III, MD,[a] Faisal G. Bakaeen, MD,[b] Marc Ruel, MD, MPH,[c] Marc R. Moon, MD,[d] S. Christopher Malaisrie, MD,[e] John H. Calhoon, MD,[f] Leonard N. Girardi, MD,[g] and Robert Guyton, MD,[h] for the American Association for Thoracic Surgery and The Society of Thoracic Surgeons

J Thorac Cardiovasc Surg 2022;163:1362-5
Ann Thorac Surg 2022;113:1065-8 0003-4975/$36.00
https://doi.org/10.1016/j.athoracsur.2021.12.003

The AATS and STS have **three areas of concern** with the guidelines as written:

(1) **Downgrading** of CABG in the treatment of three-vessel coronary artery disease (CAD); **COR I → IIb**

(2) **Lack of recognition of the superior long-term benefits of CABG** vs PCI in decreasing repeat reintervention and postprocedural myocardial infarctions.

COR	LOE	RECOMMENDATION
2a	B-R	1. In patients with SIHD and multivessel CAD appropriate for either CABG or PCI, revascularization is reasonable to lower the risk of cardiovascular events such as spontaneous MI, unplanned urgent re-vascularizations, or cardiac death (1-8).

(3) **Awarding** a **COR I to the radial artery** as a CABG conduit.

JCS
Journal of Chest Surgery
https://doi.org/10.5090/jcs.22.087
pISSN: 2765-1606 eISSN: 2765-1614
J Chest Surg. 2022;55(5):361-363

Editorial

Joint Statement of the Korean Society for Thoracic and Cardiovascular Surgery and the Korean Society for Coronary Artery Surgery of Cardiology// Cardiovascular Coronary Arter

Hyun Keun Chee, M.D.[1], Ho
Jun Sung Kim, M.D.[6], Jin He
Man-Jong Baek, M.D.[11], Sul
Kyung Hwan Kim, M.D.[3], Je
Thoracic and Cardiovascul

ELSEVIER

Canadian Journal of Cardiology 38 (2022) 705–708

Editorial

Missing the Goal With the 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization*

Marc Ruel, MD, MPH,[a] Anne Williams, MD,[b] Maral Ouzounian, MD, PhD,[c]
Louise Sun, MD, SM,[d] Jean-Francois Légaré, MD,[e]
Michael E. Farkouh, MD,[h] Edgar Chedrawy,
Jennifer Higgins, MD, MSc,[k] Kim Connelly,
David Bewick, MD,[n] Richard Whitlock, MD
Rakesh C. Aro

Ann Thorac Cardiovasc Surg 2022; 28: 4A–6A

Online February 9, 2022
doi: 10.5761/atcs.s.22-10000

Statement

The Japanese Society for Cardiovascular Surgery, The Japanese Association for Thoracic Surgery and The Japanese Association for Coronary Artery Surgery Do Not Endorse Chapter 7.1 in the 2021 ACC/AHA/SCAI Coronary Revascularization Guidelines

Hitoshi Yokoyama, MD, President
On behalf of the Japanese Society for Cardiovascular Surgery
Yoshiki Sawa, MD, President
On behalf of the Japanese Association for Thoracic Surgery
Hirokuni Arai, MD, President
On behalf of the Japanese Association for Coronary Artery Surgery

2018 ESC/EACTS Guidelines on Myocardial Revascularization

Recommendation for the type of revascularization in patients with stable coronary artery disease with suitable coronary anatomy for both procedures and low predicted surgical mortality[d]

Recommendations according to extent of CAD	CABG		PCI	
	Class[a]	Level[b]	Class[a]	Level[b]
One-vessel CAD				
Without proximal LAD stenosis.	IIb	C	I	C
With proximal LAD stenosis.[68,101,139–144]	I	A	I	A
Two-vessel CAD				
Without proximal LAD stenosis.	IIb	C	I	C
With proximal LAD stenosis.[68,70,73]	I	B	I	C
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
Three-vessel CAD without diabetes mellitus				
Three-vessel disease with low SYNTAX score (0 - 22).[102,105,121,123,124,135,149]	I	A	I	A
Three-vessel disease with intermediate or high SYNTAX score (>22).[c 102,105,121,123,124,135,149]	I	A	III	A
Three-vessel CAD with diabetes mellitus				
Three-vessel disease with low SYNTAX score 0–22.[102,105,121,123,124,135,150–157]	I	A	IIb	A
Three-vessel disease with intermediate or high SYNTAX score (>22).[c 102,105,121,123,124,135,150–157]	I	A	III	A

VIEWPOINT

2021 Coronary Revascularization Guidelines—Lessons in the Importance of Data Scrutiny and Reappraisal of Evidence

JAMA Surgery March 2023 Volume 158, Number 3

Faisal G. Bakaeen, MD
Coronary Center, Department of Thoracic and Cardiovascular Surgery, Heart, Vascular, and Thoracic Institute, Cleveland Clinic, Cleveland, Ohio.

Danny Chu, MD
Division of Cardiac Surgery, Department of Cardiothoracic Surgery, University of Pittsburgh School of Medicine, University of Pittsburgh Medical Center Heart & Vascular Surgery, Pittsburgh, Pennsylvania.

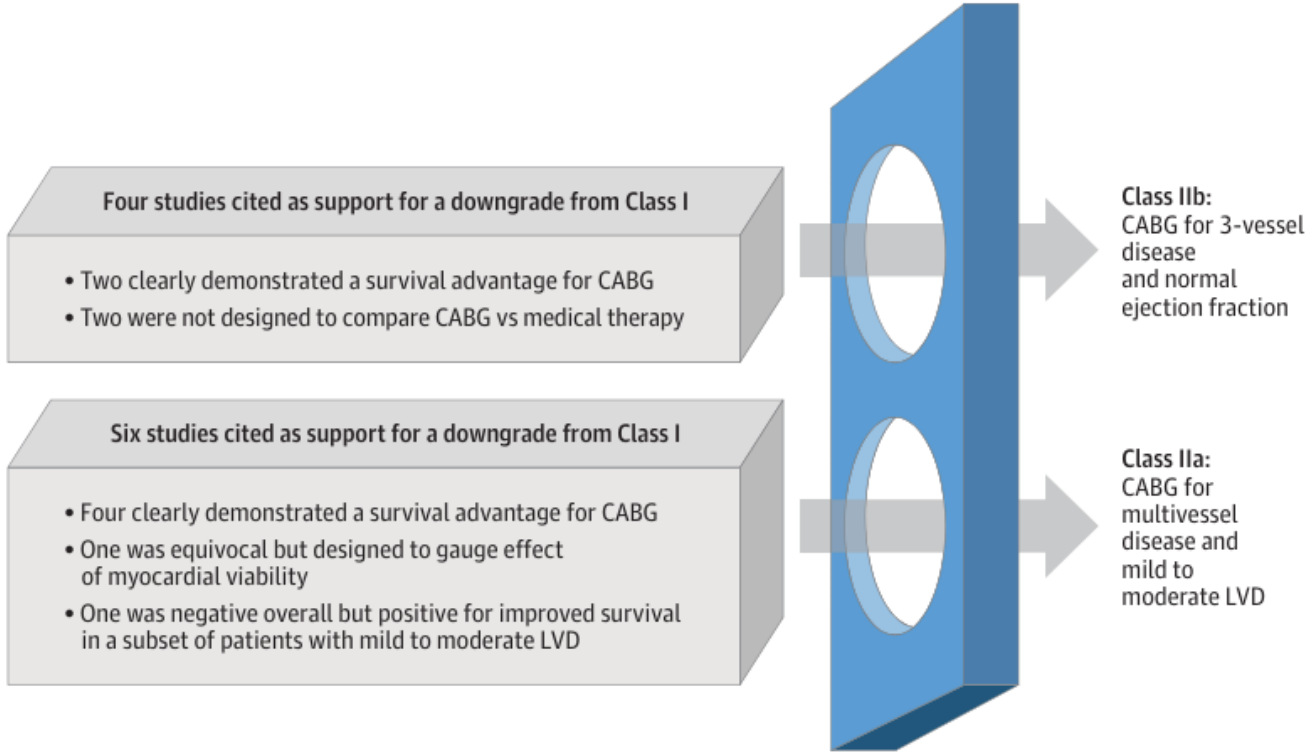
Victor Dayan, MD, PhD
Centro Cardiovascular Universitario, Montevideo, Uruguay.

The goal of clinical practice guidelines is to summarize the best available evidence and make recommendations in line with this evidence. The 2021 American College of Cardiology (ACC)/American Heart Association (AHA)/Society for Cardiovascular Angiography & Interventions (SCAI) guidelines for coronary artery revascularization were published last December and generated significant controversy.[1,2]

The central issue was the downgrade of coronary artery bypass grafting (CABG) relative to medical therapy (MT) in patients with stable ischemic heart disease and severe 3-vessel disease, with survival as the end point: from Class I (strong recommendation) to Class IIb (weak recommendation) in patients with normal ejection fraction and from Class I to Class IIa (moderate recommendation) in patients with mild to moderate left ventricular dysfunction.

Rebuttal editorials from the Society of Thoracic Surgeons and American Association for Thoracic Surgery, in addition to statements of concern, were issued by various cardiac surgery organizations from across the globe.[2] Proponents of the guidelines argue that the recommendations are accurate and that the root cause of the disagreement is the difference in interpretation of the evidence by the writing committee and the professional surgical associations. We disagree.

Figure. Evidence Based on the References Cited in the Recommendation Tables of the 2021 American College of Cardiology/American Heart Association/Society for Cardiovascular Angiography & Interventions Guidelines



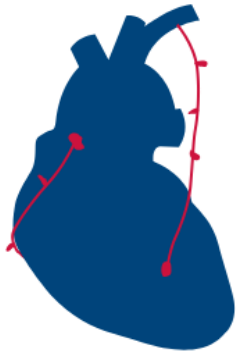
Evidence does not support down grading CABG

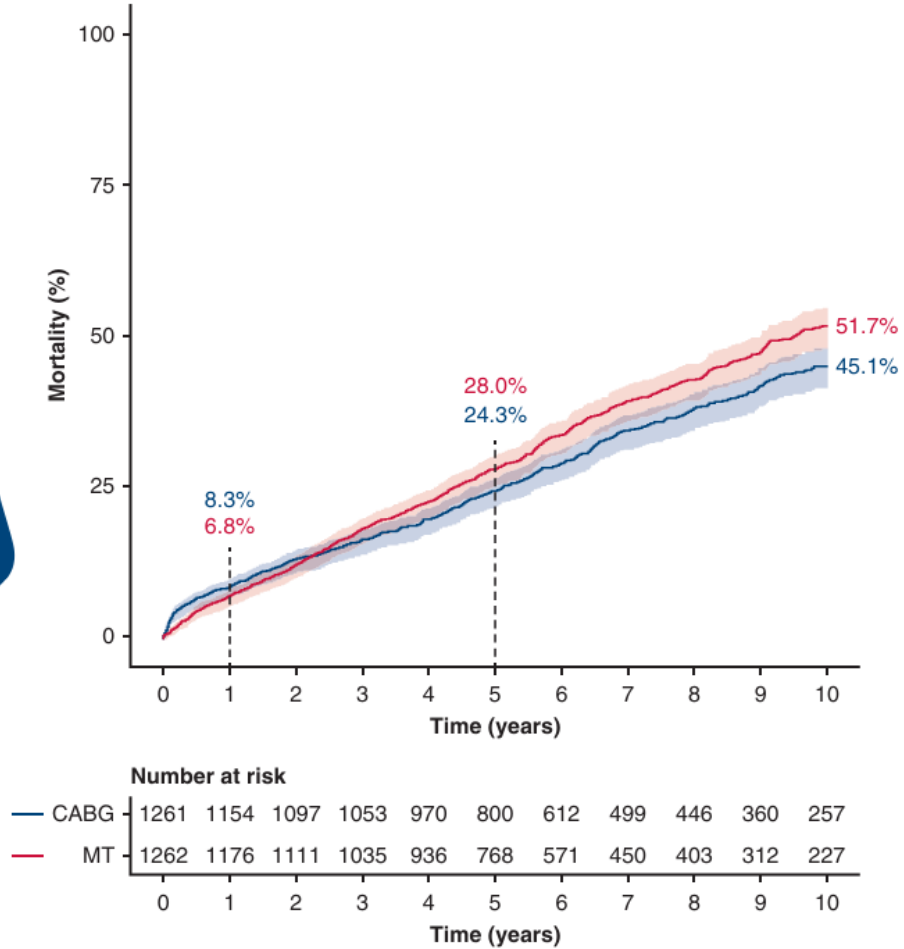
no CABG arm, and CABG constituted a mere 16% of the revascularization procedures. The trials excluded patients with complex coronary artery disease, with very few patients satisfying the guidelines definition of sig-

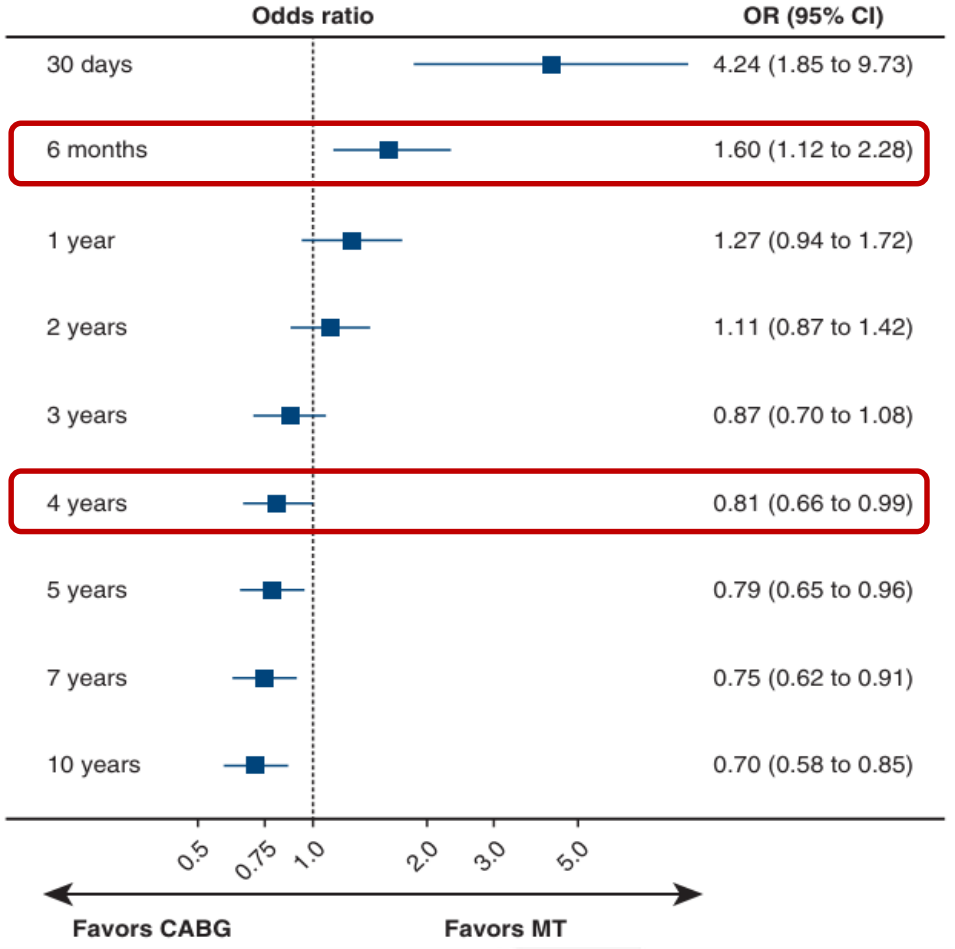
Coronary artery bypass grafting versus medical therapy in patients with stable coronary artery disease: An individual patient data pooled meta-analysis of randomized trials

Mario Gaudino, MD, PhD, MSCE,[a] Katia Audisio, MD,[a] Whady A. Hueb, MD, PhD,[b] Gregg W. Stone, MD,[c] Michael E. Farkouh, MD,[d] Antonino Di Franco, MD,[a] Mohamed Rahouma, MD,[a] Patrick W. Serruys, MD, PhD,[e] Deepak L. Bhatt, MD, MPH,[f] Giuseppe Biondi Zoccai, MD,[g,h] Salim Yusuf, DPhil, FRSC, OC,[i] Leonard N. Girardi, MD,[a] Stephen E. Fremes, MD,[j] Marc Ruel, MD, MPH,[k] and Bjorn Redfors, MD PhD[l,m,n]

J Thorac Cardiovasc Surg 2024;167:1022-32







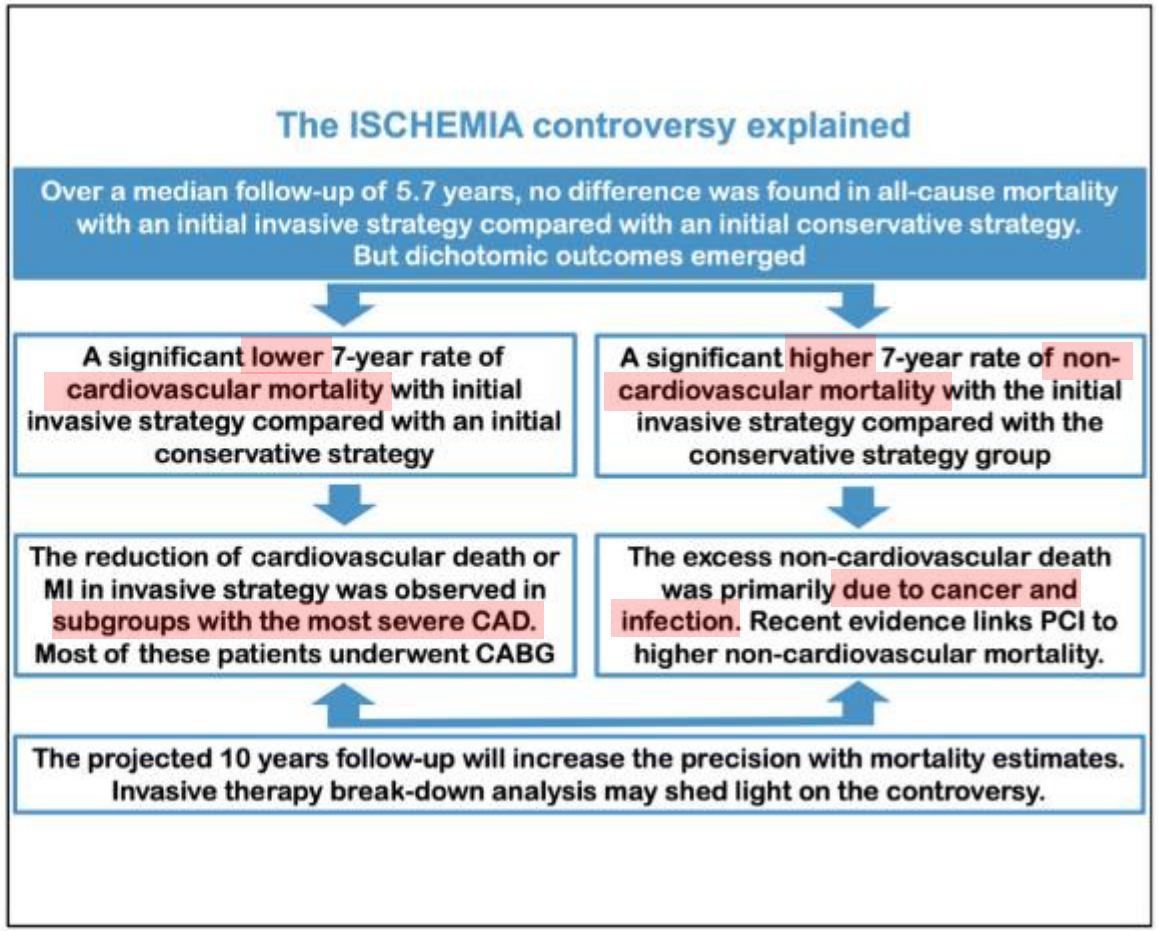
The ISCHEMIA trial revisited: setting the record straight on the benefits of coronary bypass surgery and the misinterpretation of a landmark trial

European Journal of Cardio-Thoracic Surgery 2023, 64(5), ezad361

Walter J. Gomes[a,*], Mateo Marin-Cuartas [b,*], Faisal Bakaeen[c], J. Rafael Sádaba[d], Victor Dayan [e], Rui Almeida [f], Alessandro Parolari[g], Patrick O. Myers [h] and Michael A. Borger [b]

Summary

CABG reduces the long-term risks of myocardial infarction and mortality in advanced coronary artery disease. The ISCHEMIA trial findings of a significantly lower rate of cardiovascular mortality and a higher rate of noncardiovascular mortality with an invasive strategy in patients with reversible ischemia are in agreement with other lines of evidence but have been misinterpreted to result in a downgrading of CABG in recent guidelines. We herein attempt to clarify and correct this misinterpretation.



CONCLUSIONS: The ISCHEMIA trial findings are aligned with previous evidence and should not be used to downgrade recommendations in recent guidelines for the indisputable benefits of CABG.

STS/AATS-endorsed rebuttal to 2023 ACC/AHA Chronic Coronary Disease Guideline: A missed opportunity to present accurate and comprehensive revascularization recommendations

J Thorac Cardiovasc Surg 2023;166:1115-8

Faisal G. Bakaeen, MD,[a] Marc Ruel, MD,[b] John H. Calhoon, MD,[c] Leonard N. Girardi, MD,[d] Robert Guyton, MD,[e] Dawn Hui, MD,[c] Rosemary F. Kelly, MD,[f] Thomas E. MacGillivray, MD,[g] S. Christopher Malaisrie, MD,[h] Marc R. Moon, MD,[i] Joseph F. Sabik III, MD,[j] Peter K. Smith, MD,[k] Lars G. Svensson, MD, PhD,[a] and Wilson Y. Szeto, MD,[l] for the American Association for Thoracic Surgery and The Society of Thoracic Surgeons

Not addressed by the 2023 CCD Guideline are the survival recommendations for coronary artery bypass grafting (CABG) vs medical therapy (MT) in patients with 3-vessel CAD and an ejection fraction (EF) >0.35.[1] The 2021 ACC/AHA/SCAI Guideline downgraded CABG from class I to class IIa in patients with moderate left ventricular dysfunction and to class IIb in patients with normal left ventricular function. These downgrades are not based on randomized data or robust scientific facts and resulted in international criticism and disapproval.[3-7]

Inaccurate CABG Recommendations Persist in the 2023 ACC/AHA CCD Guideline

The 2023 ACC/AHA Guideline was a missed opportunity to present accurate recommendations.

CENTRAL MESSAGE

The 2023 ACC/AHA Chronic Coronary Disease Guideline incorporates salient sections on many aspects of coronary disease, but falls short in addressing important issues on coronary revascularization.

2a	B-R

4. In patients with CCD and multivessel CAD appropriate for either CABG or PCI, revascularization in addition to GDMT is reasonable to lower the risk of cardiovascular events such as spontaneous MI, unplanned urgent revascularizations, or cardiac death.*[13-20]

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

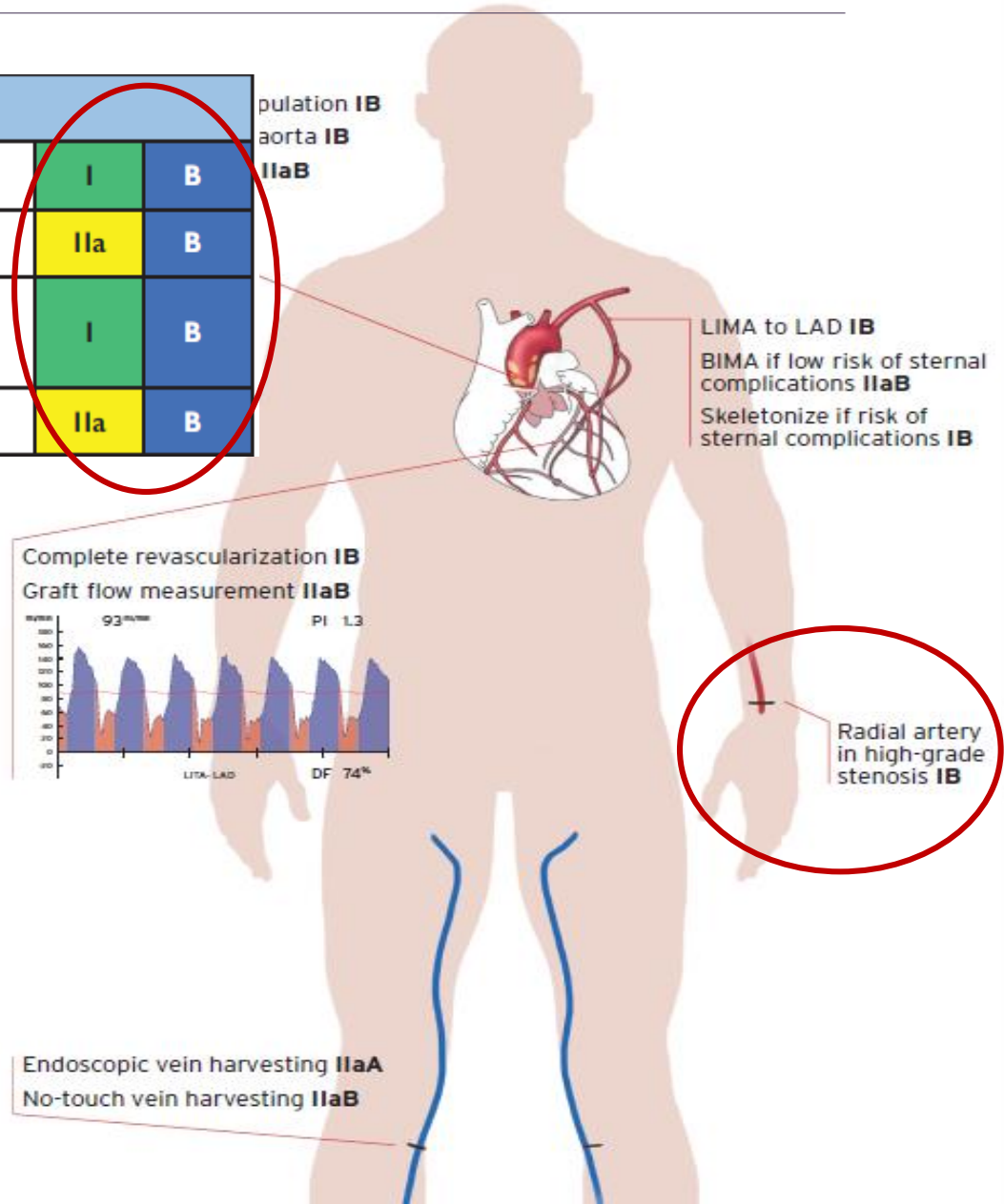
Bypass Conduits in Patients Undergoing CABG

COR	LOE	RECOMMENDATIONS	TAKE-HOME MESSAGE NO. 5
1	B-R	1. In patients undergoing isolated CABG, the use of a radial artery is recommended in preference to a saphenous vein conduit to graft the second most important, significantly stenosed, non-LAD vessel to improve long-term cardiac outcomes (1-3).	
1	B-NR	2. In patients undergoing CABG, an IMA, preferably the left, should be used to bypass the LAD when bypass of the LAD is indicated to improve survival and reduce recurrent ischemic events (4-9).	
2a	B-NR	3. In patients undergoing CABG, bilateral IMA (BIMA) grafting by experienced operators can be beneficial in appropriate patients to improve long-term cardiac outcomes (3,10-12).	

2018 ESC/EACTS Guidelines on Myocardial Revascularization

Conduit selection		
Arterial grafting with IMA to the LAD system is recommended.[453,454,546]	I	B
An additional arterial graft should be considered in appropriate patients.[467,482,547–551]	IIa	B
The use of the radial artery is recommended over the saphenous vein in patients with high-grade coronary artery stenosis.[d 482,549,550,552,553]	I	B
BIMA grafting should be considered in patients who do not have a high risk of sternal wound infection.[e 467,547,548,551]	IIa	B

pulation **IB**
aorta **IB**
IIaB



The Society of Thoracic Surgeons Clinical Practice Guidelines on Arterial Conduits for Coronary Artery Bypass Grafting

Gabriel S. Aldea, MD, Faisal G. Bakaeen, MD, Jay Pal, MD, PhD, Stephen Fremes, MD, Stuart J. Head, MD, PhD, Joseph Sabik, MD, Todd Rosengart, MD, A. Pieter Kappetein, MD, PhD, Vinod H. Thourani, MD, Scott Firestone, MS, and John D. Mitchell, MD

Aldea et al. Ann Thorac Surg 2016;101:801–9

Internal thoracic arteries (ITAs) should be used to bypass the left anterior descending (LAD) artery when bypass of the LAD is indicated (class of recommendation [COR] I, level of evidence [LOE] B). As an adjunct to left internal thoracic artery (LITA), a second arterial graft (right ITA or radial artery [RA]) should be considered in appropriate patients with inadequate LITA grafts), use of a RA graft is reasonable when grafting coronary targets with severe stenoses (COR IIa, LOE: B). When RA grafts are used, it is reasonable to use pharmacologic agents to reduce acute intraoperative and perioperative spasm (COR IIa, LOE C). The right gastroepiploic artery may be considered in

- ✓ As an adjunct to LITA to LAD (or in patients with inadequate LITA grafts), use of a RA graft is reasonable when grafting coronary targets with severe stenoses (COR IIa, LOE B),
- ✓ When RA grafts are used, it is reasonable to use pharmacologic agents to reduce acute intraoperative and perioperative spasm (COR IIa, LOE C).

and enhanced sternal stabilization may be considered (COR IIb, LOE C). As an adjunct to LITA to LAD (or in

(Ann Thorac Surg 2016;101:801–9)

Do not Endorse 2021 Coronary Revascularization Guidelines

The American Association for Thoracic Surgery and The Society of Thoracic Surgeons reasoning for not endorsing the 2021 ACC/AHA/SCAI Coronary Revascularization Guidelines

Joseph F. Sabik III, MD,[a] Faisal G. Bakaeen, MD,[b] Marc Ruel, MD, MPH,[c] Marc R. Moon, MD,[d] S. Christopher Malaisrie, MD,[e] John H. Calhoon, MD,[f] Leonard N. Girardi, MD,[g] and Robert Guyton, MD,[h] for the American Association for Thoracic Surgery and The Society of Thoracic Surgeons

➢ **Awarding a COR I to the radial artery as a CABG conduit**

- The radial artery COR I is similar to the COR for IMA grafting and higher than for bilateral IMA grafting (IIa).
- Generally requiring at least a 75% stenosis of a LCx with a good distal vessel or a tighter stenosis of a RCA, also with a good distal vessel.
- Also excluded were patients with poor left ventricle or right ventricle function who were likely to require inotropic support in the early postoperative period.

➔ that its COR is similar to internal mammary artery and higher than bilateral internal mammary artery grafting, especially without appropriate qualifiers, does not appear justified. This should be a **COR IIa recommendation** and should include appropriate qualifiers.

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

Radial and Femoral Approaches for PCI

COR	LOE	RECOMMENDATIONS	TAKE-HOME MESSAGE NO. 6
1	A	1. In patients with ACS undergoing PCI, a radial approach is indicated in preference to a femoral approach to reduce the risk of death, vascular complications, or bleeding (64-67).	
1	A	2. In patients with SIHD undergoing PCI, the radial approach is recommended to reduce access site bleeding and vascular complications (67-70).	

Dual Antiplatelet Therapy in Patients After PCI

COR	LOE	RECOMMENDATION	TAKE-HOME MESSAGE NO. 7
2a	A	1. In selected patients undergoing PCI, shorter-duration DAPT (1 to 3 months) is reasonable with subsequent transition to P2Y12 inhibitor monotherapy to reduce the risk of bleeding events (71-74).	

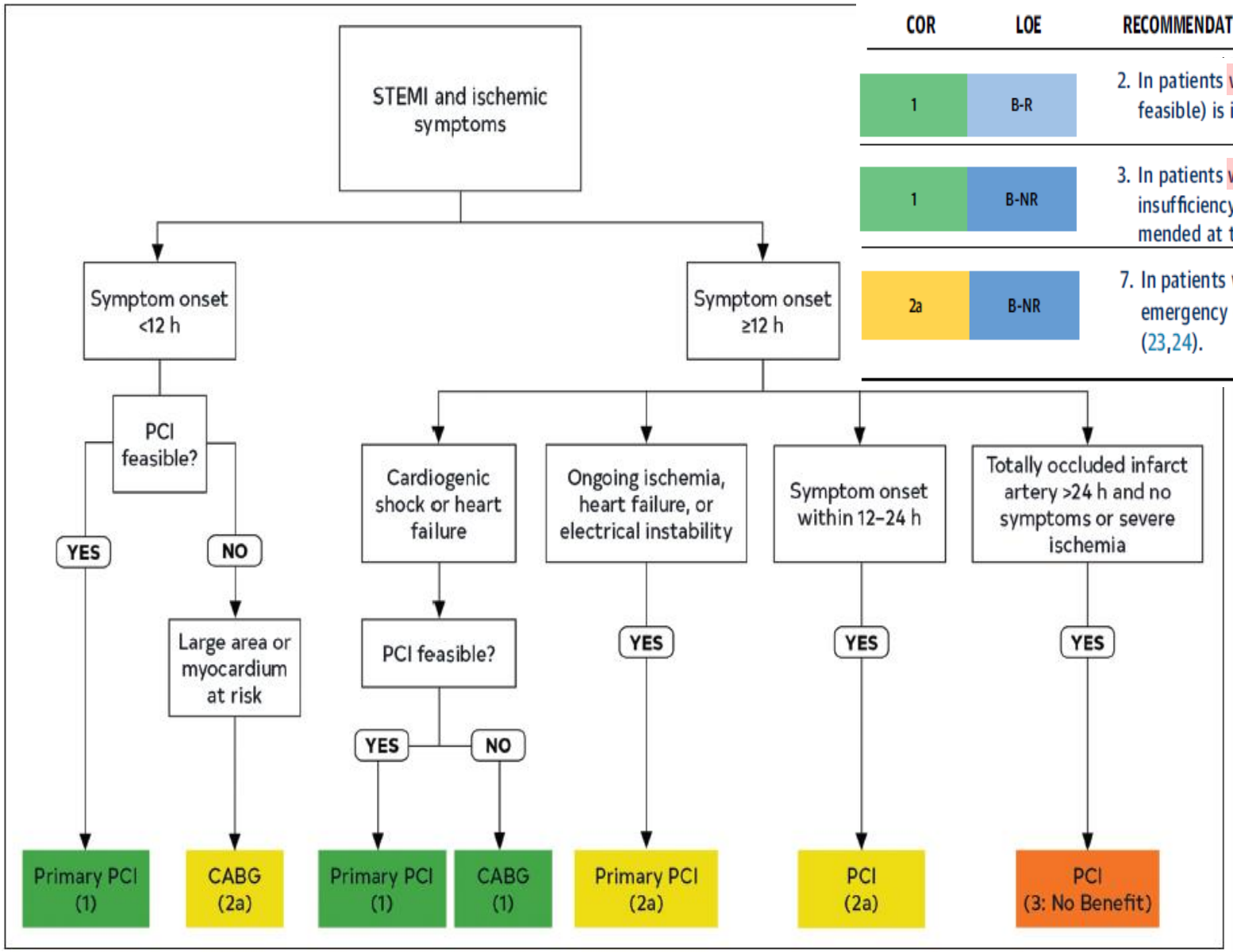
2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

Revascularization of the Noninfarct Artery in Patients With STEMI

COR	LOE	RECOMMENDATIONS	TAKE-HOME MESSAGE NO. 8
1	A	1. In selected hemodynamically stable patients with STEMI and multivessel disease, after successful primary PCI, staged PCI of a significant noninfarct artery stenosis is recommended to reduce the risk of death or MI (77-80).	
2a	C-EO	2. In selected patients with STEMI with complex multivessel noninfarct artery disease, after successful primary PCI, elective CABG is reasonable to reduce the risk of cardiac events.	
2b	B-R	3. In selected hemodynamically stable patients with STEMI and low-complexity multivessel disease, PCI of a noninfarct artery stenosis may be considered at the time of primary PCI to reduce cardiac event rates (77,78,81-83).	
3: Harm	B-R	4. In patients with STEMI complicated by cardiogenic shock, routine PCI of a noninfarct artery at the time of primary PCI should not be performed because of the higher risk of death or renal failure (84-86).	

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

- Indications for Revascularization in STEMI (Patients Without Fibrinolytics).



COR	LOE	RECOMMENDATIONS
1	B-R	2. In patients with STEMI and cardiogenic shock or hemodynamic instability, PCI or CABG (when PCI is not feasible) is indicated to improve survival, irrespective of the time delay from MI onset (6,7).
1	B-NR	3. In patients with STEMI who have mechanical complications (e.g., ventricular septal rupture, mitral valve insufficiency because of papillary muscle infarction or rupture, or free wall rupture), CABG is recommended at the time of surgery, with the goal of improving survival (8,9).
2a	B-NR	7. In patients with STEMI in whom PCI is not feasible or successful, with a large area of myocardium at risk, emergency or urgent CABG can be effective as a reperfusion modality to improve clinical outcomes (23,24).

아주대학교의료원
Ajou University Medical Center

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

Patients With Diabetes

COR	LOE	RECOMMENDATIONS	TAKE-HOME MESSAGE NO. 9
1	A	1. In patients with diabetes and multivessel CAD with involvement of the LAD, who are appropriate candidates for CABG, CABG (with a LIMA to the LAD) is recommended in preference to PCI to reduce mortality and repeat revascularizations (87-94).	
2a	B-NR	2. In patients with diabetes, who have multivessel CAD amenable to PCI and an indication for revascularization and are poor candidates for surgery, PCI can be useful to reduce long-term ischemic outcomes (95,96).	
2b	B-R	3. In patients with diabetes, who have left main stenosis and low- or intermediate-complexity CAD in the rest of the coronary anatomy, PCI may be considered an alternative to CABG to reduce major adverse cardiovascular outcomes (91,97).	

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

Predicting Patient Risk of Death With CABG

COR	LOE	RECOMMENDATION	TAKE-HOME MESSAGE NO. 10
1	B-NR	1. In patients who are being considered for CABG, calculation of the Society of Thoracic Surgeons risk score is recommended to help stratify patient risk (98,99).	

Defining Coronary Artery Lesion Complexity: Calculation of the SYNTAX Score

COR	LOE	RECOMMENDATION	TAKE-HOME MESSAGE NO. 10
2b	B-NR	1. In patients with multivessel CAD, an assessment of CAD complexity such as the SYNTAX score may be useful to guide revascularization (115-118)	

TABLE 5 Assessment of Risk Factors Not Quantified in the STS Score

Risk Factor	Assessment Tool
Cirrhosis	Model for End-Stage Liver Disease (MELD) score (98-100,112-114)
Frailty	Gait speed (102,104-108,110)
Malnutrition	Malnutrition Universal Screening Tool (MUST) (101,103,109,110)

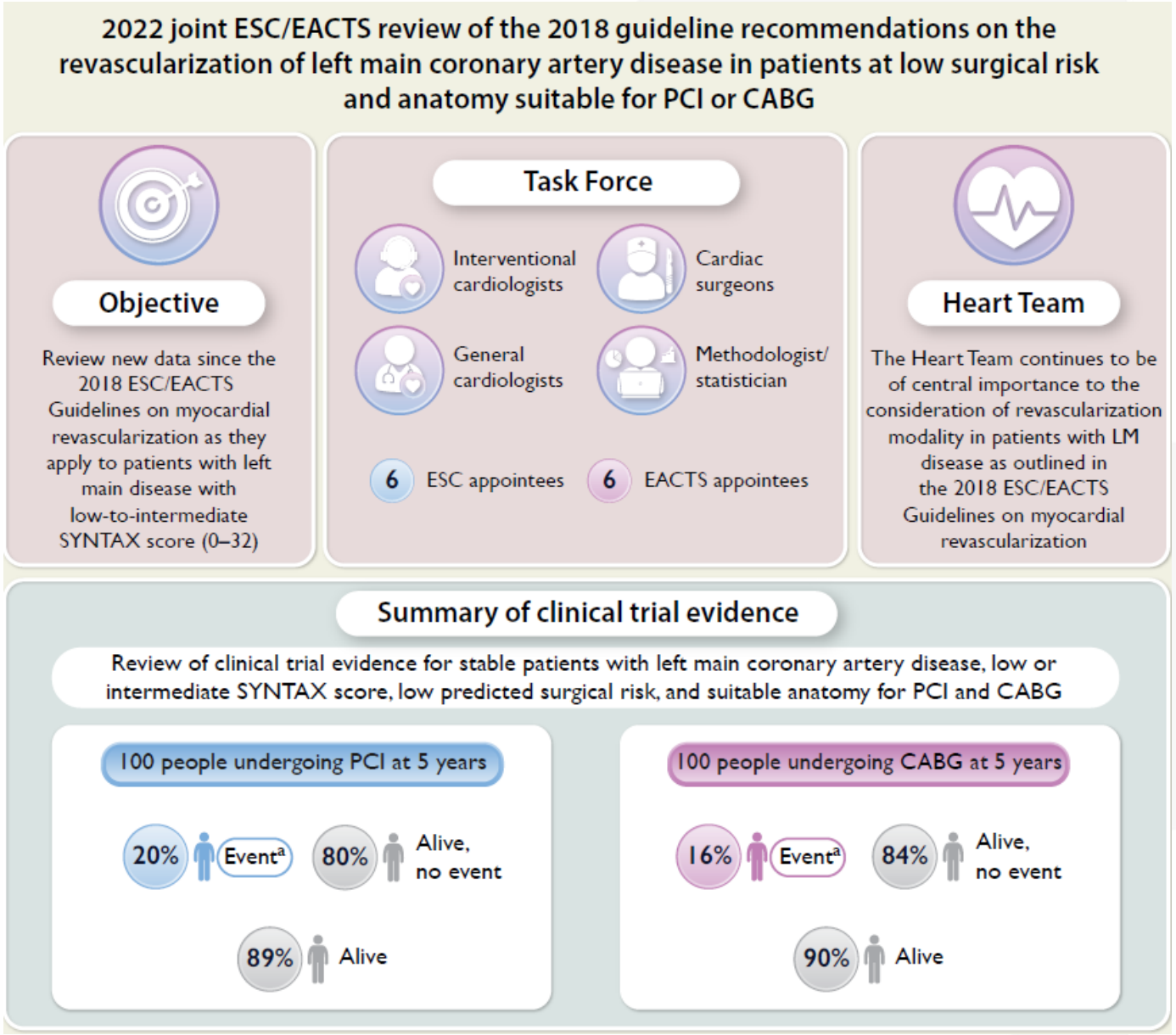
TABLE 6 Angiographic Features Contributing to Increasing Complexity of CAD

Multivessel disease	Severe tortuosity
Left main or proximal LAD artery lesion	Aorto-ostial stenosis
Chronic total occlusion	Diffusely diseased and narrowed segments distal to the lesion
Trifurcation lesion	Thrombotic lesion
Complex bifurcation lesion	Lesion length >20 mm
Heavy calcification	

2022 Joint ESC/EACTS review of the 2018 guideline recommendations on the revascularization of **left main coronary artery disease**

Task Force structure and summary of clinical evidence of 2022 ESC/EACTS review of the 2018 guideline recommendations on the revascularization of left main coronary artery disease.

European Heart Journal (2023) **44**, 4310–4320
https://doi.org/10.1093/eurheartj/ehad476



(event = composite of death, MI, or stroke)

2018 ESC/EACTS Guidelines on Myocardial Revascularization

Recommendation for the type of revascularization in patients with stable coronary artery disease with suitable coronary anatomy for both procedures and low predicted surgical mortality[d]

Recommendations according to extent of CAD	CABG		PCI	
	Class[a]	Level[b]	Class[a]	Level[b]
One-vessel CAD				
Without proximal LAD stenosis.	IIb	C	I	C
With proximal LAD stenosis.[68,101,139–144]	I	A	I	A
Two-vessel CAD				
Without proximal LAD stenosis.	IIb	C	I	C
With proximal LAD stenosis.[68,70,73]	I	B	I	C
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
Three-vessel CAD without diabetes mellitus				
Three-vessel disease with low SYNTAX score (0 - 22).[102,105,121,123,124,135,149]	I	A	I	A
Three-vessel disease with intermediate or high SYNTAX score (>22).[c 102,105,121,123,124,135,149]	I	A	III	A
Three-vessel CAD with diabetes mellitus				
Three-vessel disease with low SYNTAX score 0–22.[102,105,121,123,124,135,150–157]	I	A	IIb	A
Three-vessel disease with intermediate or high SYNTAX score (>22).[c 102,105,121,123,124,135,150–157]	I	A	III	A

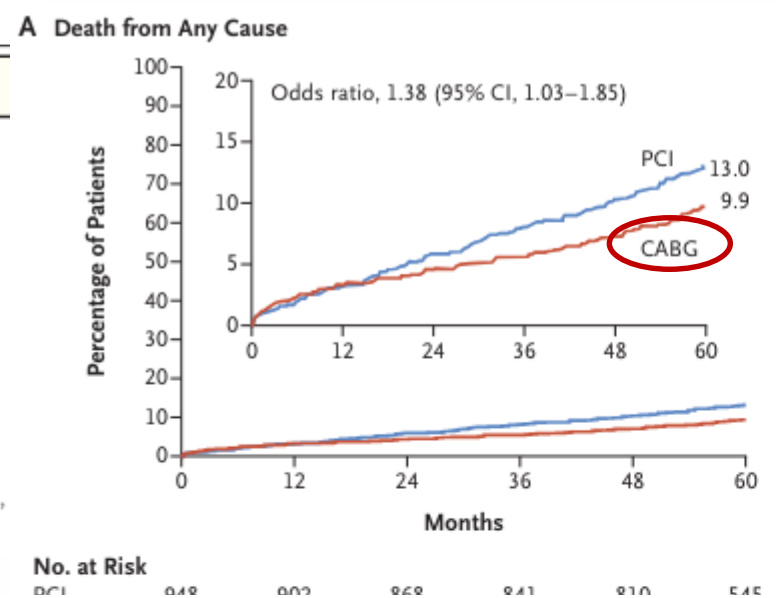
The NEW ENGLAND JOURNAL of MEDICINE

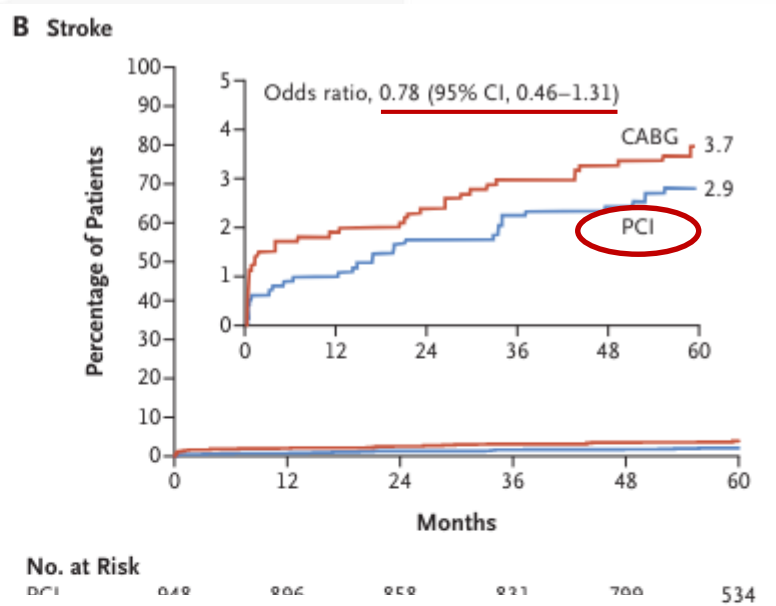
ORIGINAL ARTICLE

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*

N Engl J Med 2019;381:1820-30.





Left main bifurcation or trifurcation stenosis ≥50% (core laboratory assessment)	PCI (N=948) Events/total patients *no.*	PCI (N=948) Event rate %	CABG (N=957) Events/total patients *no.*	CABG (N=957) Event rate %	Odds Ratio (95% CI)
Yes	171/771	22.7	136/741	19.0	1.24 (0.96–1.60)
No	32/171	19.2	35/195	18.9	1.05 (0.62–1.79)
SYNTAX score (site reported)					
≤22	119/560	21.9	106/588	18.7	1.21 (0.90–1.62)
23–32	84/386	22.2	70/366	20.0	1.16 (0.81–1.67)
SYNTAX score (core laboratory assessment)					
≤22	49/294	17.2	58/364	16.7	0.99 (0.65–1.51)
23–32	91/392	23.7	69/346	20.7	1.22 (0.85–1.74)
≥33	56/228	25.0	42/216	20.0	1.36 (0.86–2.15)

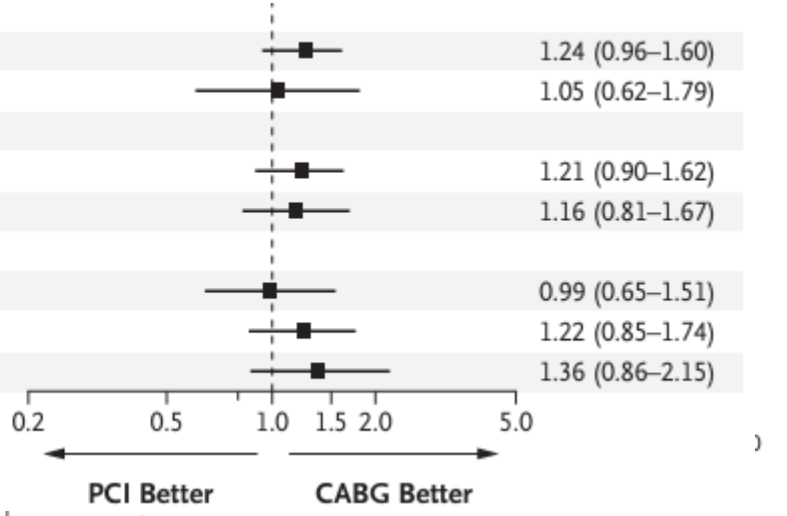


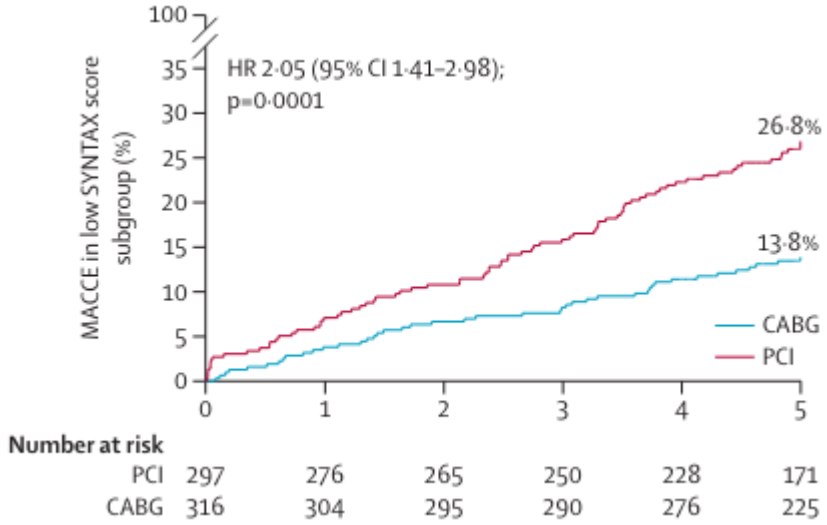
Figure 3. Time-to-First-Event Curves for the Components of the Primary and Secondary Composite Outcomes through 5-Year Follow-up.

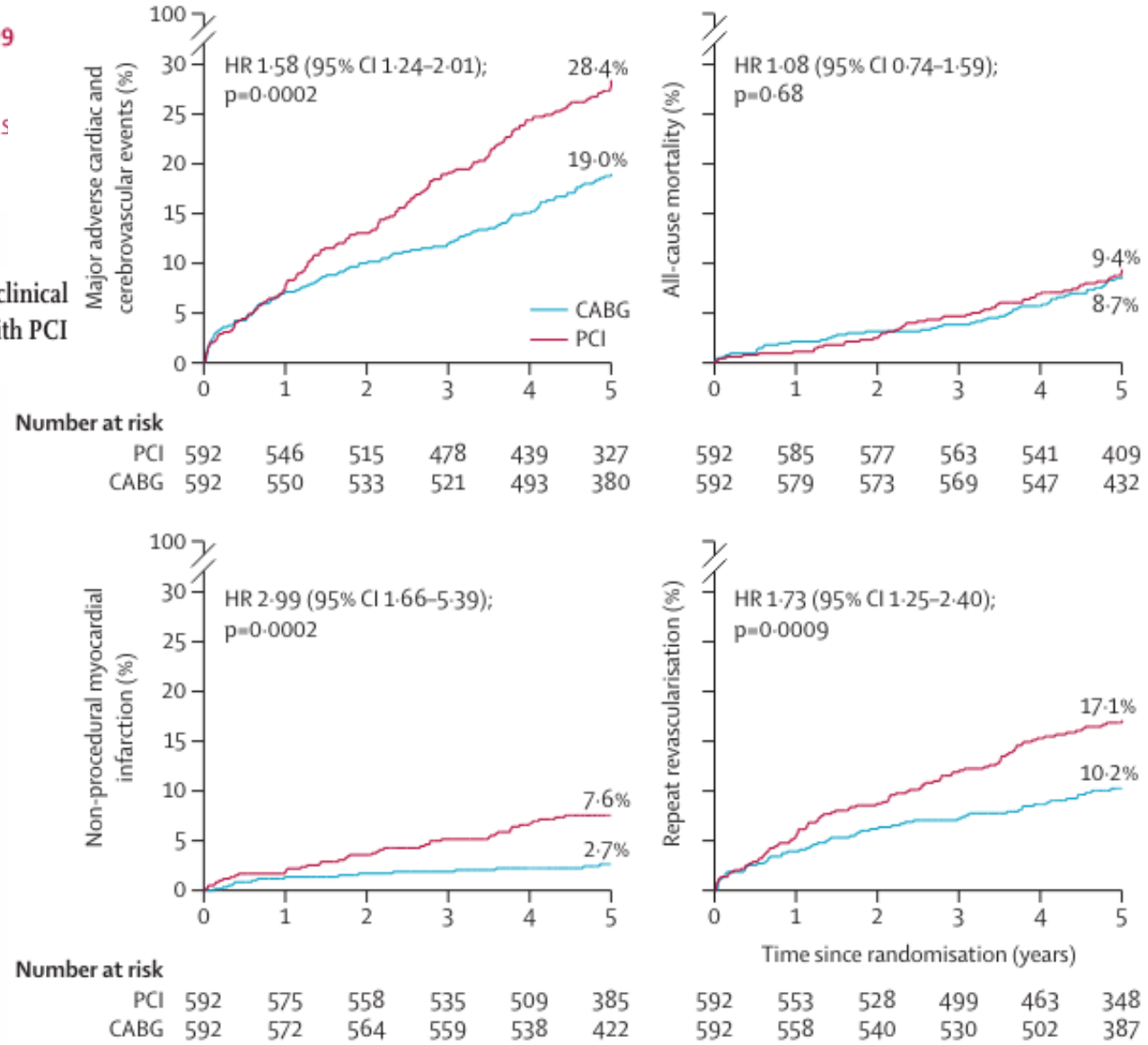
Percutaneous coronary angioplasty versus coronary artery bypass grafting in the treatment of unprotected left main stenosis: updated 5-year outcomes from the randomised, non-inferiority NOBLE trial

Lancet 2020; 395: 191–99

*Niels R Holm, Timo Mäkikallio, M Mitchell Lindsay, Mark S Spence, Andrejs Erglis, Ian B A Menown, Thor Trovik, Thomas Kellerth, Gintaras Kalinauskas, Lone Juul Hune Mogensen, Per H Nielsen, Matti Niemelä, Jens F Lassen, Keith Oldroyd, Geoffrey Berg, Peteris S Simon J Walsh, Alastair N J Graham, Petter C Endresen, Ole Fröbert, Uday Trivedi, Vesa Anttila, David Hildick-Smith, Leif Thuesen, Evald H Christiansen, for the NOBLE investigators**

Interpretation In revascularisation of left main coronary artery disease, PCI was associated with an inferior clinical outcome at 5 years compared with CABG. Mortality was similar after the two procedures but patients treated with PCI had higher rates of non-procedural myocardial infarction and repeat revascularisation.





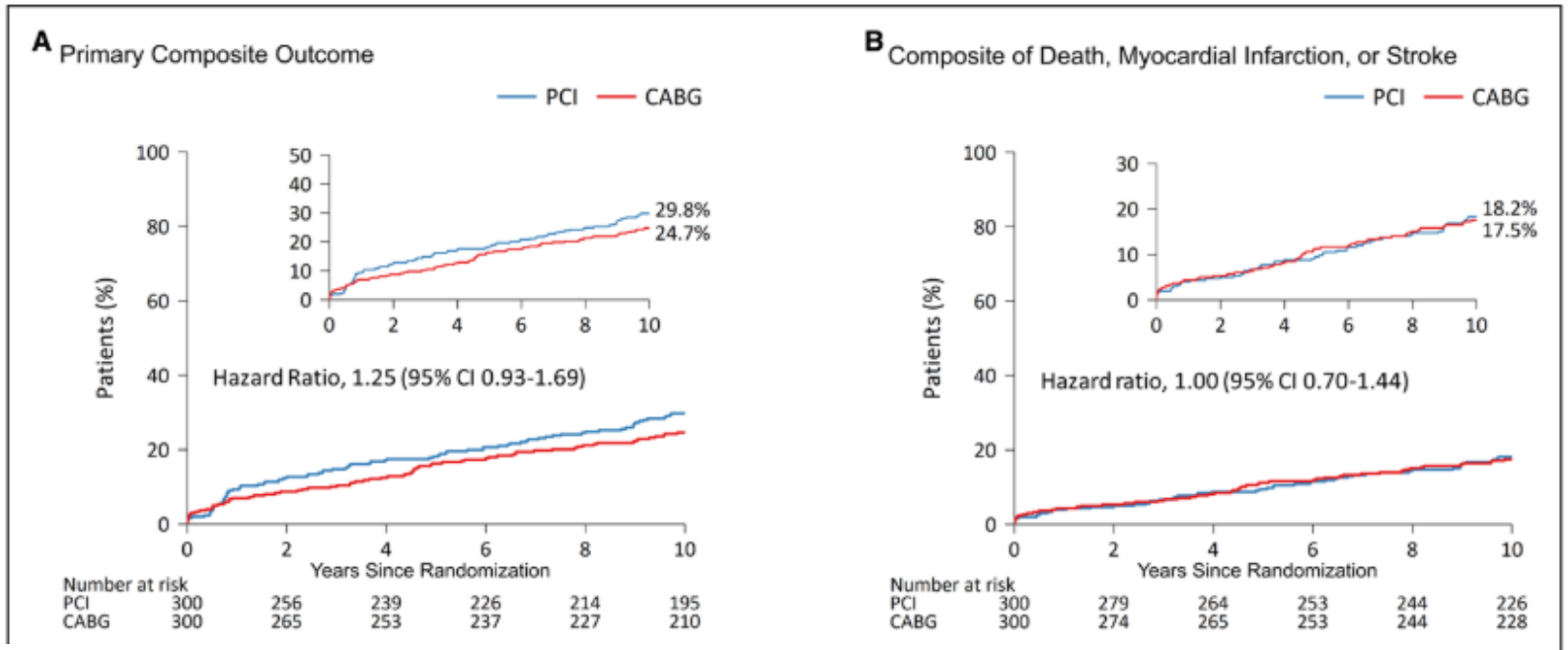
Circulation

ORIGINAL RESEARCH ARTICLE

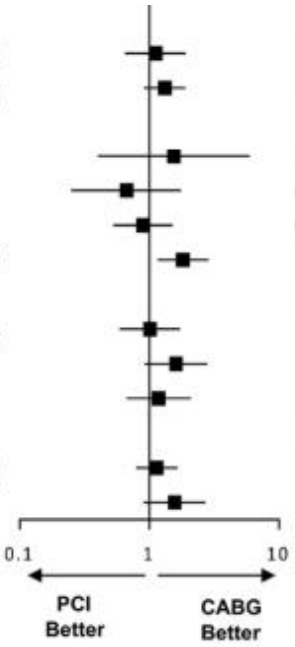
Ten-Year Outcomes After Drug-Eluting Stents Versus Coronary Artery Bypass Grafting for Left Main Coronary Disease

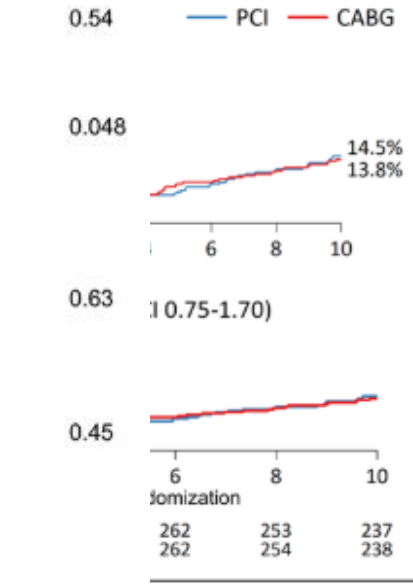
Extended Follow-Up of the PRECOMBAT Trial

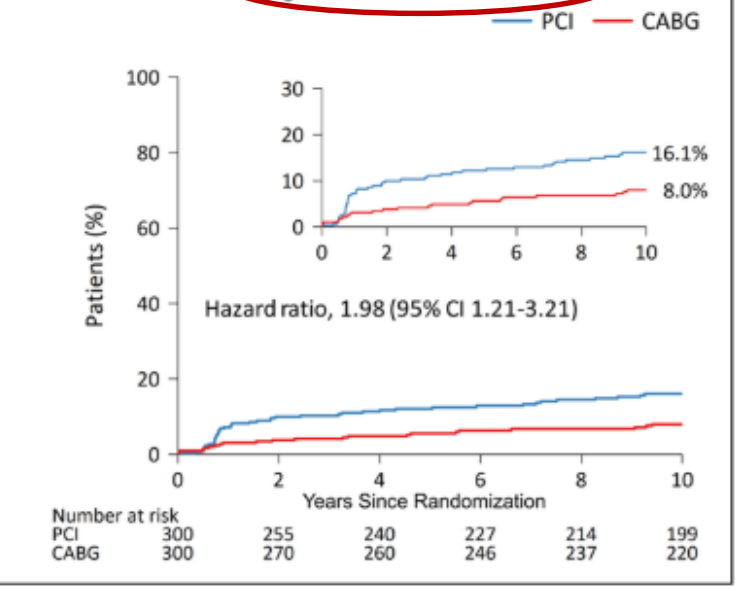
Circulation. 2020;141:1437–1446. DOI: 10.1161/CIRCULATIONAHA.120.046039



Subgroup	PCI	CABG	Hazard Ratio (95% CI)	P value for Interaction
	no. /total no. (%)			
Left main involvement				0.54
Ostium and shaft	23/99 (23.6)	23/111 (21.2)	1.12 (0.65–1.91)	
Distal bifurcation	64/200 (33.1)	48/183 (28.1)	1.32 (0.91–1.90)	
Extent of diseased vessel				0.048
Left main only	4/27 (15.1)	5/34 (14.9)	1.55 (0.40–5.95)	
Left main with 1-vessel disease	6/50 (13.4)	10/53 (19.8)	0.67 (0.25–1.76)	
Left main with 2-vessel disease	30/101 (30.1)	26/90 (29.9)	0.89 (0.53–1.51)	
Left main with 3-vessel disease	47/122 (40.0)	31/123 (25.6)	1.82 (1.16–2.86)	
Syntax score				0.63
≤22	27/131 (21.6)	23/109 (22.2)	1.01 (0.59–1.73)	
22-32	32/102 (31.8)	21/98 (22.2)	1.61 (0.92–2.81)	
≥33	26/58 (46.2)	24/68 (45.7)	1.18 (0.67–2.09)	
Complete revascularization				0.45
Yes	57/205 (28.3)	53/211 (25.7)	1.14 (0.79–1.65)	
No	30/95 (33.2)	19/89 (22.2)	1.57 (0.90–2.73)	







ary and key secondary outcomes through 10-year follow-up.

Percutaneous coronary intervention versus coronary artery bypass grafting in patients with three-vessel or left main coronary artery disease: 10-year follow-up of the multicentre randomised controlled SYNTAX trial

*Daniel J F M Thuijs, A Pieter Kappetein, Patrick W Serruys, Friedrich-Wilhelm Mohr, Marie-Claude Morice, Michael J Mack, David R Holmes Jr, Nick Curzen, Piroze Davierwala, Thilo Noack, Milan Milojevic, Keith D Dawkins, Bruno R da Costa, Peter Jüni, Stuart J Head, for the SYNTAX Extended Survival Investigators**

Lancet 2019; 394: 1325–34

Added value of this study

The current study is the first randomised trial that reports complete 10-year data on all-cause death in patients with de-novo three-vessel and left main coronary artery disease after PCI with drug-eluting stents versus CABG. It provides important insights into the relative effectiveness of PCI versus CABG regarding the most robust and clinically relevant outcome—all-cause death. At 10 years, no significant difference was found in all-cause death between PCI using first-generation paclitaxel-eluting stents and CABG. However, CABG provided a significant survival benefit in patients with three-vessel disease, but not in patients with left main coronary artery disease. These findings can aid decision making for patients with coronary artery disease who require PCI or CABG, accounting for differences in cardiovascular risk factors, coronary lesion complexity (eg, SYNTAX score), and the presence of three-vessel or left main coronary artery disease.

	PCI group	CABG group	HR (95% CI)	
Type of coronary disease				
Left main coronary artery disease	95/357	98/348	0·92 (0·69–1·22)	0·023
Three-vessel disease*	153/546	114/549	1·42 (1·11–1·81)	
Medically treated diabetes				
Yes	80/231	72/221	1·10 (0·80–1·52)	0·60
No	168/672	140/676	1·23 (0·98–1·53)	
Coronary disease complexity				
SYNTAX score ≤22	65/299	53/275	1·11 (0·77–1·60)	0·20†
SYNTAX score 23–32	80/310	72/300	1·07 (0·78–1·47)	
SYNTAX score ≥33	101/290	82/315	1·47 (1·10–1·96)	

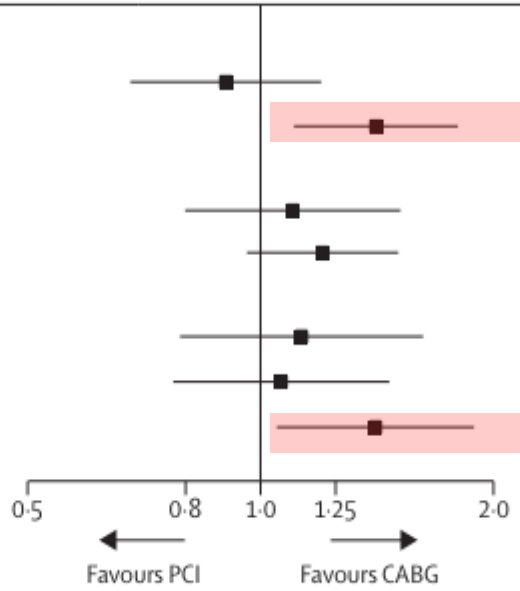


Figure 4: Forest plot of prespecified subgroup analyses of 10-year all-cause death (intention-to-treat population)

Percutaneous coronary intervention with drug-eluting stents versus coronary artery bypass grafting in left main coronary artery disease: an individual patient data meta-analysis

Marc S Sabatine*, Brian A Bergmark*, Sabina A Murphy, Patrick T O'Gara, Peter K Smith, Patrick W Serruys, A Pieter Kappetein, Seung-Jung Park, Duk-Woo Park, Evald H Christiansen, Niels R Holm, Per H Nielsen, Gregg W Stone, Joseph F Sabik, Eugene Braunwald

Lancet 2021; 398: 2247–57

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.

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

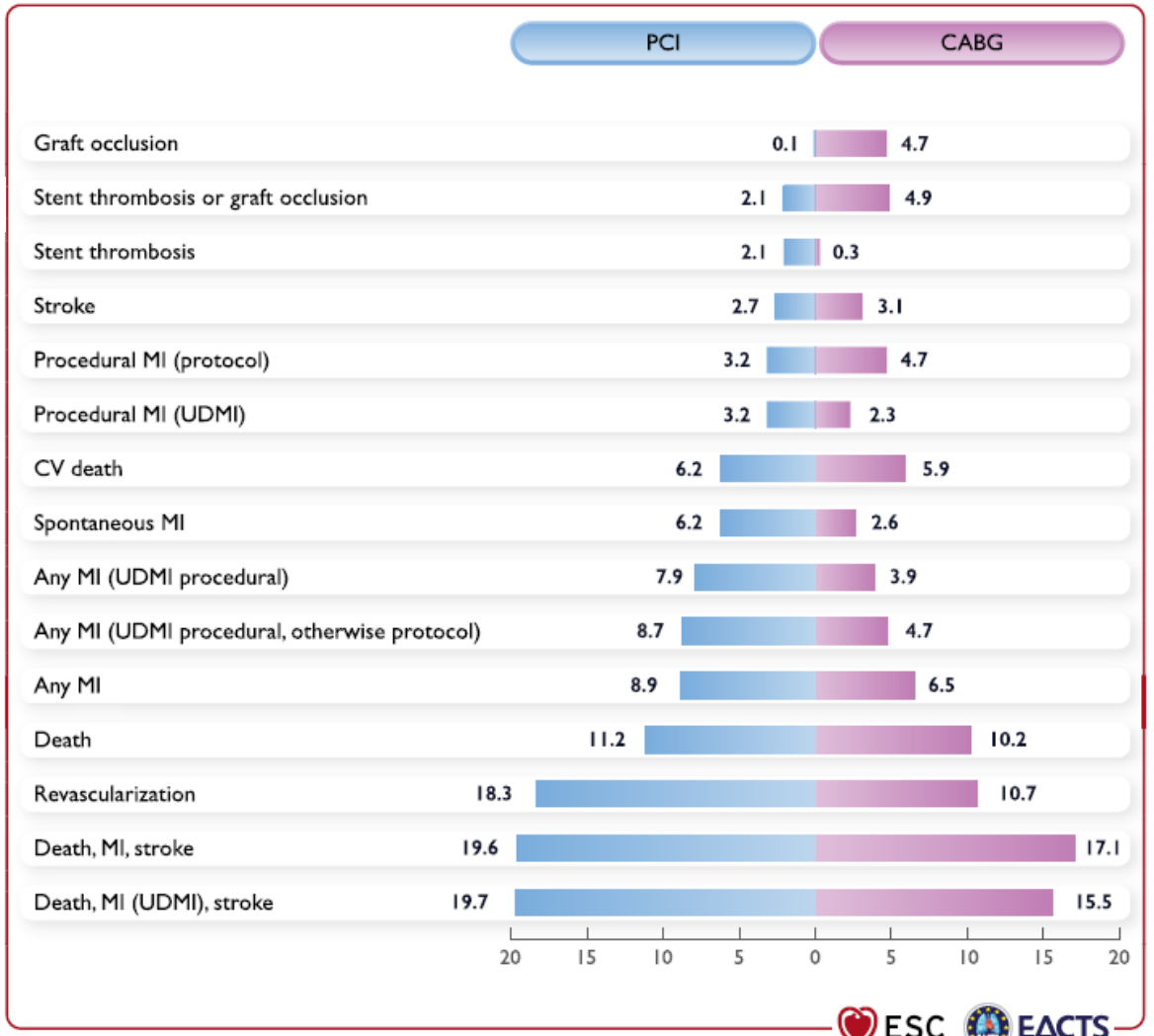


Figure 1 5-year clinical outcomes with PCI vs. CABG in pooled analysis of randomized trials. CABG, coronary artery bypass grafting; CV, cardiovascular; MI, myocardial infarction; PCI, percutaneous coronary intervention; UDMI, Universal Definition of Myocardial Infarction.

2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization

CABG in Patients Undergoing Other Cardiac Surgery

COR	LOE	RECOMMENDATIONS
1	C-LD	1. In patients undergoing valve surgery, aortic surgery, or other cardiac operations who have significant CAD, CABG is recommended with a goal of reducing ischemic events (1-11).
2b	C-LD	2. In patients undergoing valve surgery, aortic surgery, or other cardiac operations who have intermediate CAD, CABG may be reasonable with a goal of reducing ischemic events (5,7,10,12).

Use of Epiaortic Ultrasound in Patients Undergoing CABG

COR	LOE	RECOMMENDATION
2a	B-NR	1. In patients undergoing CABG, the routine use of epiaortic ultrasound scanning can be useful to evaluate the presence, location, and severity of plaque in the ascending aorta to reduce the incidence of atheroembolic complications (1-10).

Use of Cardiopulmonary Bypass in Patients Undergoing CABG

COR	LOE	RECOMMENDATIONS
2a	B-R	1. In patients with significant calcification of the aorta, the use of techniques to avoid aortic manipulation (off-pump techniques or beating heart) is reasonable to decrease the incidence of perioperative stroke when performed by experienced surgeons (1,2).
2b	B-R	2. In patients with significant pulmonary disease, off-pump surgery may be reasonable to reduce perioperative risk when performed by experienced surgeons (2-6).

Summary

- Despite the downgrades in the 2021 guidelines, the importance of CABG in patients with stable coronary artery disease remains significant. CABG plays a crucial role in improving long-term survival and reducing the risk of serious cardiovascular events.

- It is crucial to note that the data generated thus far by the ISCHEMIA trial cannot be used to justify downgrading the recommendations for CABG in patients with chronic coronary disease. CABG has consistently been shown to reduce myocardial infarction and mortality rates compared to medical therapy in patients with multivessel CAD.

- Therefore, it is essential to re-evaluate the importance of CABG based on both new and existing robust evidence and to reflect these findings in appropriate recommendations.

Thank you for your attention